



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

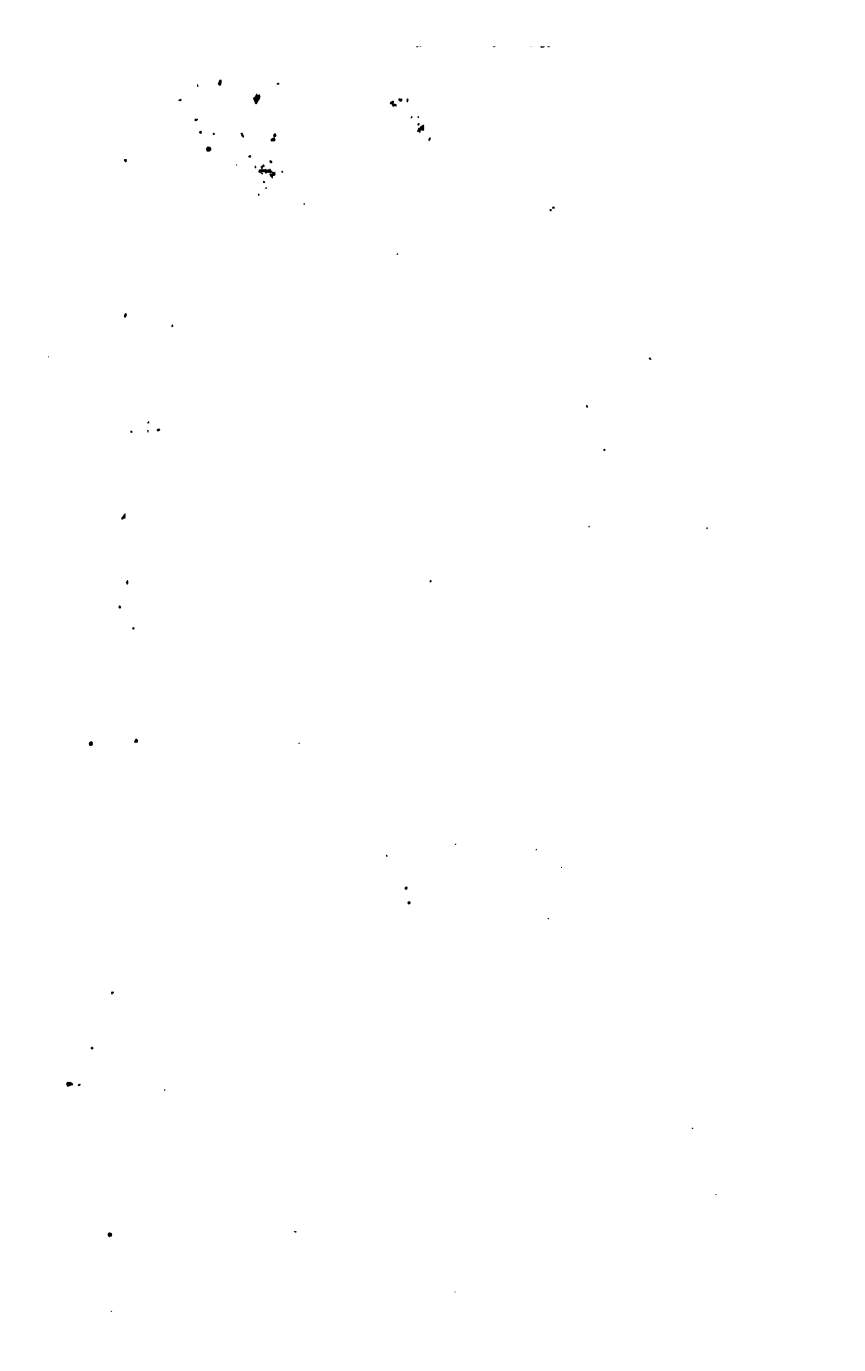
We also ask that you:

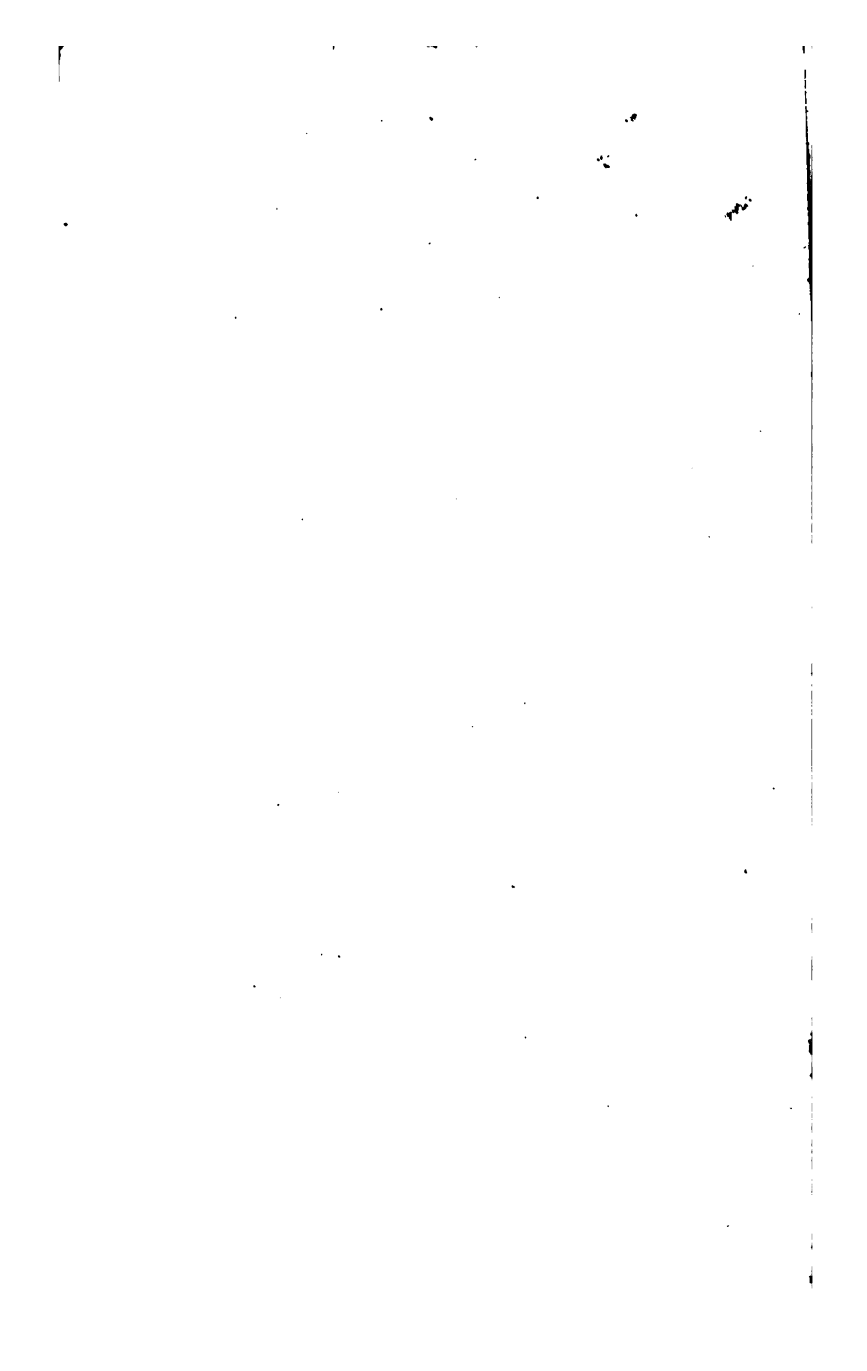
- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>







By the same Author.

Second Edition, with Corrections, in One Volume, crown
8vo. pp. 724, price 7s. 6d. cloth.

ENGLISH HISTORY

FROM THE EARLIEST PERIOD
TO OUR OWN TIMES.

With an Appendix containing Tables of Battles, Sieges, Treaties,
Biography, Colonies, and Contemporary Sovereigns.

*Expressly designed to assist Students preparing for
Examination.*

THE AUTHOR of this volume having felt the want of a History containing all the information required by Candidates preparing for the various Examinations, was induced to undertake the task of compiling the present work, in which he trusts he has embodied all that can be required to pass with credit the most searching Examination.

It contains a brief notice of every important historical event; the Anglo-Saxon government, laws, and institutions; the introduction of the feudal system; the development of our constitution; and genealogical tables showing the connection of the different dynasties.

At the end of each reign the principal discoveries have been briefly chronicled, and a summary given of Parliamentary proceeding.

The APPENDIX contains chronological tables of battles, sieges, and treaties; a short biography of every person of note; a list of British colonies and dependencies, and a table of contemporary sovereigns, tracing the rise of the different European kingdoms.

For easy reference, the most important events have been printed in Clarendon type, and a complete Index given of both text and appendix.

‘Every device is employed to help the memory. Prominent events or names are printed in larger and blacker type; chronological tables of battles, sieges, and treaties are given in an appendix, with a great deal of other very important matter.’

MUSEUM.

arranged text-book—the best we as yet know. Drawn up by an Instructor of Candidates for the Civil Service, it is a commendable preparation in history for all such candidates; while schoolmasters and private students cannot fail, with the most moderate attention, to learn from it all that they require to know of the subject. There is a section of it

‘This is an accurate, full, and well-

which explains the ancient English terms relative to the tenure of land with much simplicity and brevity.'

NATIONAL SOCIETY'S PAPER.

'This is a very useful compilation, and one that supplies an undoubted want. In nearly all those Public Examinations, which are such a prominent feature in the educational movements of the present day, the study of English History has now obtained its due recognition and encouragement; but hitherto the student has laboured under considerable disadvantages in the choice of a text-book suited to his special requirements. What the *competition wallahs* want is a synopsis of the facts of history, rather than a history proper: they want a history, that is to say, wherein the events, personages, dates, laws, &c., about which they are likely to be asked, are presented in a form calculated to strike the mind and to impress themselves on the memory; whilst they require little, if any, critical discussion. Such a book is the one before us; whereof the appendices will be found the most useful and valuable part. They consist of Chronological tables of Battles, Sieges, and Treaties; a short Biographical Dictionary; a list of British Colonies and Dependencies, with a History of how acquired; and a Table of contemporary Sovereigns. All these tabular forms are well arranged, both for casual reference and for regular didactic purposes. The things to be remembered strike the eye immediately; and the same idea has been attempted in the text itself, by means of printing in thick black type the names of all the important events, persons, and places as they occur in the narrative. Mr. LUPTON has also contrived to incorporate in his work another *desideratum*, an elementary History of the Constitution, by placing at the end of every chapter a summary of Parliamentary proceedings, and by inserting, in its proper order, an epitome of each of the principal constitutional changes. To the general student this book will prove valuable in more points than one; to candidates for competitive examinations it will undoubtedly be a great boon.'

LONDON QUARTERLY REVIEW.

'A young man of ordinary capacity who studies this history, which he can do in a very brief period, may consider

himself sufficiently read in this subject for his immediate purpose, and may confidently present himself before the Civil Service or Army examiners. The history extends from the earliest date to the present time—that is, to the year 1880; and it is so arranged and divided in periods as to impress itself most easily on the minds of readers; while the chief events are so emphasised by the aid of bold type as to take special hold of the memory. An excellent INDEX, a biographical dictionary, a list of battles, and sieges, and treaties; and tables, chronological and other, add much to the usefulness of this compendious English History.'

CIVIL SERVICE GAZETTE.

'Mr. LUPTON'S manual has several good points. It contains a brief but clear summary of all the more important events in English History; the distinctive features of the Anglo-Saxon and Norman governments, laws and institutions; the introduction of the feudal system; the development of the constitution, and a complete set of genealogical tables showing the connexion of the different dynasties. One feature seems likely to be very useful: at the end of every reign is given a carefully compiled abstract of the Parliamentary proceedings, the changes in our laws, and the principal discoveries and inventions. . . . Mr. LUPTON seems, on the whole, to have performed his task with fair success; and his manual will, we have no doubt, prove very useful to a large class of students who have neither leisure nor means to consult larger and more expensive works.'

EDUCATIONAL TIMES.

'This volume, expressly designed to assist students preparing for Examination, is well adapted for the purpose. At the end of each reign the principal discoveries are briefly chronicled, and a summary given of Parliamentary proceedings. The most important events are printed in conspicuous type—this, of course, is intended to facilitate reference, and give the student the opportunity of refreshing his memory at the last moment in the speediest way. The compiler has evidently had much practical experience of the want that he has laboured to supply.'

SPECTATOR.

ARITHMETIC

FOR THE USE OF SCHOOLS.

DESIGNED TO ASSIST CANDIDATES PREPARING FOR EXAMINATION.

LUPTON'S ARITHMETIC FOR SCHOOLS.

* * The Answers to the Questions, Problems, and Exercises in this work (in all about 2,500 examples) may be had either separately or bound up with the work itself, as follows:—

ARITHMETIC FOR SCHOOLS, with the ANSWERS (the complete work), price 3s. 6d.

ARITHMETIC FOR SCHOOLS, without the ANSWERS, price 2s. 6d.

The ANSWERS separately, price 1s. stitched.



LONDON:
LONGMANS, GREEN, AND CO.

1867.

181. g. 18.

LONDON
PRINTED BY SPOTTISWOODE AND CO.
NEW-STREET SQUARE

PREFACE.

THIS WORK is essentially a Book of Exercises, as it contains (including the Specimen Papers) 2,500 Examples; for the Author has found, from long experience, that a good knowledge of Arithmetic can only be acquired by constant exercise in the different Rules. For the same reason, many of the examples are designedly long, as the only means of insuring accuracy of work. The failures of Candidates for Examination almost invariably arise more from a want of correctness in working, than from the want of a knowledge of Arithmetic.

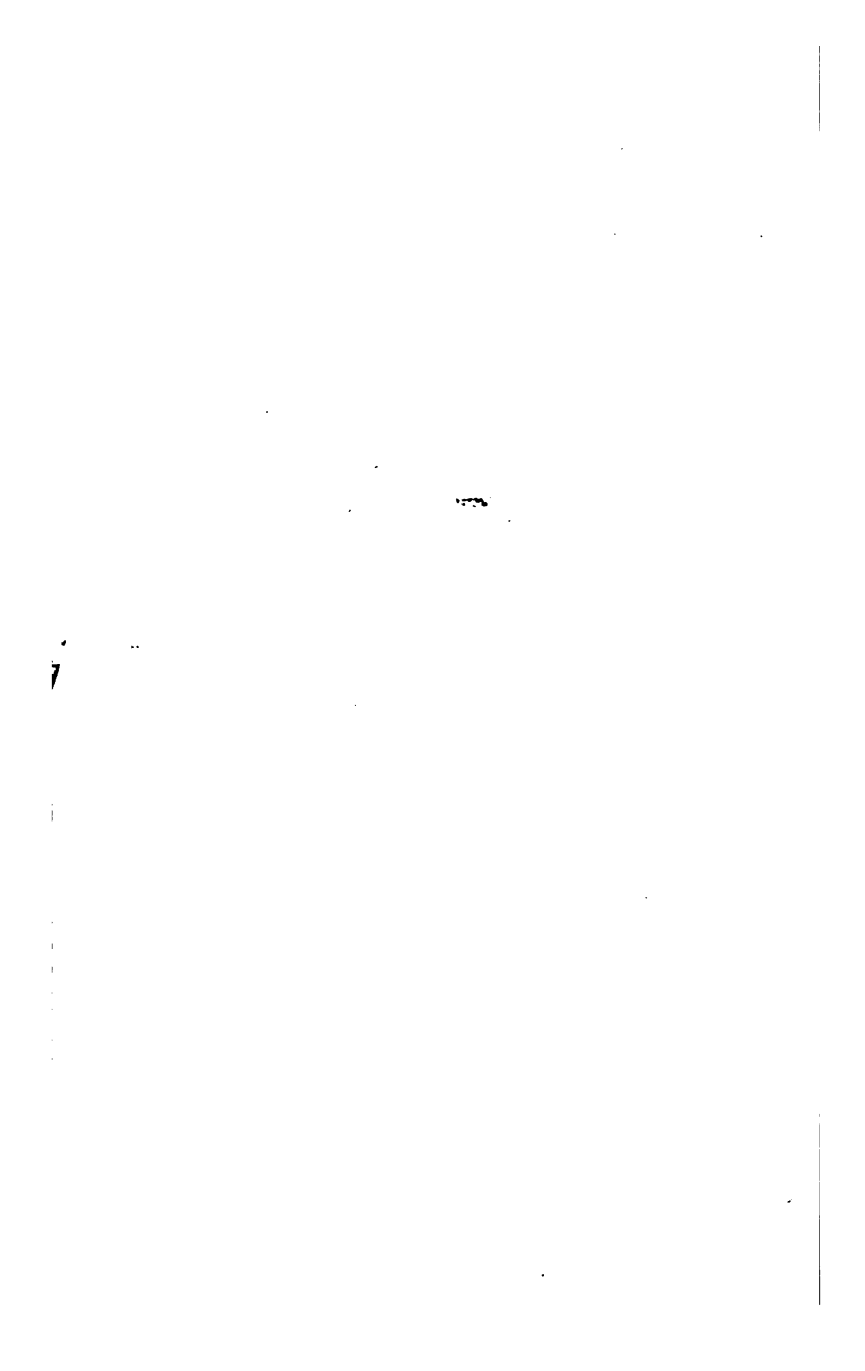
To give Students an idea of the style of the different Examinations, Examples have been carefully selected from the Army and Civil Service Examination Papers, with the entire Papers on Arithmetic, published in the last Civil Service Report. By the kind permission of the Syndicates of Oxford and Cambridge, Specimen Papers of the Local Examinations have also been added.

The work concludes with an explanation of the method of calculating the interest given by the Post Office Savings' Bank.

W. M. L.

HODDSDON :

December, 1886.



CONTENTS.

	PAGE
DEFINITIONS	1
NUMERATION AND NOTATION	2
TABLES	3
SIMPLE ADDITION	11
" SUBTRACTION	12
" MULTIPLICATION	12
" DIVISION	13
REDUCTION	13
COMPOUND ADDITION	17
" SUBTRACTION	20
" MULTIPLICATION	23
" DIVISION	24
MISCELLANEOUS EXAMPLES IN COMPOUND RULES	26
VULGAR FRACTIONS	30
GREATEST COMMON MEASURE	31
LEAST COMMON MULTIPLE	35
MISCELLANEOUS EXAMPLES IN FRACTIONS	48
DECIMALS	52
MISCELLANEOUS EXAMPLES IN DECIMALS	63
MENSURATION OF RECTANGULAR SURFACES AND SOLIDS	65
PROPORTION	70 ^a
COMPOUND PROPORTION	82
PRACTICE	86
MISCELLANEOUS EXAMPLES IN PRACTICE	90
INTEREST	92
PRESENT WORTH AND TRUE DISCOUNT	101

	PAGE
COMMERCIAL DISCOUNT	104
INSURANCE, COMMISSION, AND BROKERAGE	105
COMPOUND INTEREST	108
PROFIT AND LOSS	111
STOCKS	114
PROPORTIONAL PARTS	119
EXCHANGE	123
SQUARE ROOT	126
CUBE ROOT	128
MISCELLANEOUS EXAMPLES (GENERAL)	130
MISCELLANEOUS EXAMPLES (ARMY)	133
MISCELLANEOUS EXAMPLES (CIVIL SERVICE)	136
SPECIMEN PAPERS (CIVIL SERVICE)	144
SPECIMEN PAPERS (OXFORD)	148
SPECIMEN PAPERS (CAMBRIDGE)	150
INTEREST (POST OFFICE SAVINGS' BANK)	152
ANSWERS TO EXAMPLES	i

ARITHMETIC.

Arithmetic is that science which treats of the properties of numbers.

Numbers are either Concrete or Abstract.

Concrete numbers are those which specify a number of particular things, as 3 apples, 5 marbles.

Abstract numbers have no reference to particular objects, but simply indicate units of the same kind, as 4, 5, 6, &c.

The **Reciprocal** of a number is unity divided by that number, e.g., the Reciprocal of 2 is $\frac{1}{2}$, of $\frac{1}{3}$ is 3, and so on.

A **Prime Number** is a number not divisible without a remainder by any number except unity, as 2, 3, 5, 7, 11, &c.

The sign $+$ (plus) signifies addition, as $4 + 5 = 9$.

The sign $-$ (minus) signifies subtraction, as $5 - 4 = 1$.

The sign \times signifies multiplication, as $5 \times 4 = 20$.

The sign \div signifies division, as $12 \div 2 = 6$.

The sign $=$ signifies equal to, as $4 + 3 = 7$.

The sign $\sqrt{}$ signifies the square root to be extracted, as $\sqrt{16} = 4$.

The sign $\sqrt[3]{}$ signifies cube root to be extracted, as $\sqrt[3]{8} = 2$.

The sign $\sqrt[4]{}$ signifies fourth root to be extracted; and so on.

1, 2, 3, 4, 5, 6, 7, 8, 9, are called the nine digits, and 0 zero or nothing.

To simplify the reading of numbers we make use of what is generally called the Numeration Table.

1 Unit.
 21 Tens.
 321 Hundreds.
 4321 Thousands.
 54321 Tens of thousands.
 654321 Hundreds of thousands.
 7,654321 Millions.
 87,654321 Tens of millions.
 987,654321 Hundreds of millions.
 1987,654321 Thousands of millions.
 21987,654321 Tens of thousands of millions.
 321987,654321 Hundreds of thousands of millions.
 4,321987,654321 Billions.
 54,321987,654321 Tens of billions.
 654,321987,654321 Hundreds of billions.
 7654,321987,654321 Thousands of billions.
 87654,321987,654321 Tens of thousands of billions.
 987654,321987,654321 Hundreds of thousands of billions.
 1,987654,321987,654321 Trillions.

As it takes 6 figures to run up to hundreds of thousands, to facilitate the reading it is better to divide large numbers into periods of six figures, commencing from right to left. Taking the last line of the Numeration Table, we shall read it thus:—

Tril- lions	Bil- lions	Mil- lions	Thou- sands
1,987654,321987,654321.			

One trillion, nine hundred and eighty seven thousand six hundred and fifty four billions, Three hundred and twenty one thousand nine hundred and eighty seven millions, Six hundred and fifty four thousand three hundred and twenty one.

Octil- lions	Septil- lions	Sextil- lions	Quintil- lions	Quadril- lions	Trillions	Billions	Millions	Thou- sands
987654,321987,654321,987654,321987,654321,987654,321987,654321 ;								

and so on to nonillions, decillions, &c.

ROMAN NOTATION.

M	D	C	L	X	V	I
1000	500	100	50	10	5	1

NUMERATION AND NOTATION.

EXERCISE I.

Write in words the following quantities :—

4016; 360013; 20,013645; 6,340005,017034; 4000,007643; 30,000001;
8,130640,001700,634001; 90,105003; 77,005003; 607035.

Write down in figures :—

Six hundred and three thousand and fifty; Seven millions three thousand and forty; Eight hundred and forty thousand and twenty; Ten millions four thousand and eight; Eight thousand millions one thousand and two; Eleven hundred and two millions seventy thousand and fifty; Four hundred and one thousand three hundred and one; Two hundred millions eight thousand and eleven; Four hundred millions five hundred and ten; Seventy thousand one hundred and three.

MULTIPLICATION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

MONEY.

4 Farthings	make	1 Penny.
12 Pence . . .		1 Shilling.
2 Shillings . . .		1 Florin.
5 Shillings . . .		1 Crown.
20 Shillings . . .		1 Pound or sovereign.
21 Shillings . . .		1 Guinea.
27 Shillings . . .		1 Moidore.
13 Shillings and fourpence		1 Mark.
4 Pence		1 Groat.

d.	make	s.	d.	d.	make	s.	d.	d.	make	s.	d.
12		1	0	50		4	2	96		8	0
20		1	8	60		5	0	100		8	4
24		2	0	70		5	10	108		9	0
30		2	6	72		6	0	110		9	2
36		3	0	80		6	8	120		10	0
40		3	4	84		7	0	130		10	10
48		4	0	90		7	6	132		11	0

140d. make 11s. 8d.

144d. make 12s.

WEIGHTS AND MEASURES.

TROY.

Used for gold, silver, jewellery, and philosophical experiments.

24 Grains	make	1 Pennyweight.
20 Pennyweights . . .		1 Ounce = 480 Grains.
12 Ounces		1 Pound = 5760 Grains.
3½ Grains		Carat of diamond.

A carat of gold is now a mere arbitrary term to signify its fineness. Pure or virgin gold is said to be 24 carats fine; standard gold is 22 carats fine, being composed of 22 carats of fine gold and 2 of copper or alloy. From 20 lbs. of standard gold are coined $934\frac{1}{2}$ sovereigns; consequently 1 lb. = $46\frac{7}{10}$ sovereigns, and 1 oz. = $3\frac{1}{10}\frac{3}{4}$ sovereigns = £3 17s. 10½d. per oz., or £46 14s. 6d. per lb. = the Mint price of gold. From this it will be seen that a sovereign weighs 5 dwts. $3\frac{1}{10}\frac{7}{16}$ grs. As standard gold is $\frac{1}{12}$ pure gold, therefore the value of pure gold is £4 4s. 11½d.

per ounce. Gold is a legal tender to any amount. The best jewellery is 18 carats fine; but by Act of Parliament it is allowed to make jewellery of 15, 12, and 9 carats.

Standard silver coins are made of a metal containing 37 parts in 40 of pure silver and 3 of copper. Every pound troy is coined into 66s., consequently 1 oz. is equal 5s. 6d., the Mint price of standard silver, and as this is $\frac{37}{40}$ pure silver, therefore pure silver is 5s. $11\frac{1}{3}$ d. per oz. A shilling weighs 3 dwts. $15\frac{1}{11}$ grs.

Silver is a legal tender for any sum not exceeding £2.

In the new bronze coinage 48 pence are coined from 1 lb. avoirdupois. This is only a legal tender to the amount of 1 shilling.

In 1670 the new standard was established by Charles II., and has so continued ever since; and in 1718 the current value was raised to the present value. In 1817 an Act was passed legalising the present standard.

AVOIRDUPOIS.

FOR ALL COMMON GOODS.

16 Drams	.	make	.	1 Ounce.
16 Ounces	.	.	.	1 Pound.
8 Pounds	.	.	.	1 Stone of Meat, in London.
14 Pounds	.	.	.	1 Stone.
2 Stones or 28 Pounds	.	.	.	1 Quarter.
4 Quarters or 112 lbs.	.	.	.	1 Hundredweight.
280 lbs. or 20 Stones or $2\frac{1}{2}$ Cwt.	.	.	.	1 Sack of Flour.
20 Hundredweight	.	.	.	1 Ton.
7000 Grains Troy or Apoth.	.	.	.	1 lb. Avoirdupois.

APOTHECARIES.

USED IN PREPARING MEDICINES.

20 Grains	.	make	.	1 Scruple = 3
3 Scruples	.	.	.	1 Dram = 3
8 Drams	.	.	.	1 Ounce = 3
12 Ounces	.	.	.	1 Pound = lb. = 5760 gr.
20 Fluid Ounces	.	.	.	1 Pint.

LENGTH.

4 Inches	. . . make	. . . 1 Hand.
12 Inches	. . . . .	. . . 1 Foot.
3 Feet	. . . . .	. . . 1 Yard.
6 Feet	. . . . .	. . . 1 Fathom.
$5\frac{1}{2}$ Yards	. . . . .	. . . 1 Rod, Pole, or Perch.
4 Poles, or 22 Yards, or 100 Links	. . . . .	. . . 1 Chain.
10 Chains, or 40 Poles, or 220 Yards	. . . . .	. . . 1 Furlong.
8 Furlongs, or 80 Chains, or 1760 Yards	. . . . .	. . . 1 Mile.
3 Miles	. . . . .	. . . 1 League.
60 Geographical miles, or $69\frac{1}{2}$ English miles	. . . . .	. . . 1 Degree.

The Imperial yard of 36 in. is our standard of length, and if lost may be recovered from the knowledge that the pendulum vibrating seconds, in the lat. of London, is 39.1392 inches.

SQUARE OR LAND MEASURE.

So called because it is the square of Lineal Measure.

144 Square Inches	. make	. . . 1 Square Foot.
9 Square Feet	. . . . .	. . . 1 Square Yard.
100 Square Feet	. . . . .	. . . 1 Square of Flooring.
$30\frac{1}{4}$ Square Yards	. . . . .	. . . 1 Square Rod, Pole, or Perch.
40 Poles	. . . . .	. . . 1 Rood.
4 Roods or 4840 yards	. . . . .	. . . 1 Acre.
640 Acres	. . . . .	. . . 1 Square Mile.
$272\frac{1}{4}$ Square Feet, $1\frac{1}{2}$ bricks thick	. . . . .	. . . 1 Rod of Brickwork.

To reduce other brickwork to $1\frac{1}{2}$ bricks or standard thickness, multiply by the number of half bricks and divide by 3.

As will be seen from above, the rod of brickwork is only $30\frac{1}{4}$ sq. yds. reduced to feet.

CLOTH.

$2\frac{1}{4}$ Inches	. make	. . . 1 Nail.
4 Nails	. . . . .	. . . 1 Quarter.
3 Quarters	. . . . .	. . . 1 Flemish Ell.
4 Quarters	. . . . .	. . . 1 Yard.
5 Quarters	. . . . .	. . . 1 English Ell.
6 Quarters	. . . . .	. . . 1 French Ell.

SOLIDITY.

This is the cube of Lineal Measure.

1728 Cubic Inches	make	1 Cubic Foot.
27 Cubic Feet		1 Cubic Yard.
40 of Rough or 50 Cubic Feet of Hewn Timber		1 Load of Wood.
42 Cubic Feet		1 Ton of Shipping.

CAPACITY.

DRY MEASURE.

2 Pints	make	1 Quart.
2 Quarts		1 Pottle.
2 Pottles or 4 Quarts		1 Gallon.
2 Gallons		1 Peck.
4 Pecks or 8 Gallons		1 Bushel.
4 Bushels		1 Coomb or Sack.
2 Coombs or 8 Bushels		1 Quarter.
5 Quarters		1 Load or Wey.
2 Loads		1 Last.

CAPACITY.

BEER, WINE, AND SPIRITS.

4 Gills	make	1 Pint.
2 Pints		1 Quart.
4 Quarts		1 Gallon.
9 Gallons		1 Firkin.
2 Firkins or 18 Gallons		1 Kilderkin.
2 Kilderkins or 36 Gallons		1 Barrel.
$1\frac{1}{2}$ Barrels or 54 Gallons		1 Hogshead of Beer.
63 Gallons		1 Hogshead of Wine.
2 Hogsheads		1 Pipe.
252 Gallons or 2 Pipes		1 Tun.
108 Gallons of Sherry		1 Pipe.
27 Gallons of Sherry		1 Quarter Cask.
115 Gallons of Port		1 Pipe.
117 Gallons of Lisbon		1 Pipe.
92 Gallons of Madeira.		1 Pipe.

An Imperial gallon of distilled water weighs 10 lbs., and measures 277·274 cubic inches, and is the standard of capacity. 1 lb. of distilled water measures 27·7274 cub. in. and is the standard of weight.

TIME.

60 Seconds . . .	make . . .	1 Minute.
60 Minutes . . .	. . .	1 Hour.
24 Hours . . .	. . .	1 Day.
7 Days . . .	. . .	1 Week.
4 Weeks or 28 Days . . .	. . .	1 Lunar Month.
365 $\frac{1}{4}$ Days . . .	. . .	1 Julian Year.
365 Days 5 Hrs. 48 Mins. 47 $\frac{1}{2}$ Seconds	. . .	1 Solar Year.

To know when it is Leap Year divide the number of years by 4; if there be no remainder it is Leap Year.

Thirty days have September,
 April, June, and November;
 February hath twenty-eight alone,
 All the rest have thirty-one;
 Except in Leap Year, then's the time
 February's days are twenty-nine.

QUARTERLY TERMS.

ENGLAND.

Lady Day, 25th March.
 Midsummer, 24th June.
 Michaelmas, 29th September.
 Christmas, 25th December.

SCOTLAND.

Candlemas, 2nd February.
 Whitsun, 15th May.
 Lammas, 1st of August.
 Martinmas, 11th November.

Articles not mentioned in the preceding tables:—

A Fother of lead is 19 $\frac{1}{2}$ cwt., or . . .	2,184 lbs.
A Bag of rice is about . . .	168 „
A Chest of tea is generally . . .	138, 64, or 49 „
A Bushel weighs . . .	56 „
Forty Bushels make 1 Ton, or . . .	2,240 „
A Pocket of hops weighs from . . .	178 to 224 „
A Bag of hops . . .	392 „
24 Sheets of paper make . . .	1 Quire.
20 Do. do. . .	1 „, outsides.
25 Do. do. . .	1 Printers' quire.
20 Quires . . .	1 Ream.
21 $\frac{1}{2}$ Quires . . .	1 Printers' ream.
2 Reams . . .	1 Bundle.
10 Bundles . . .	1 Bale.
60 Skins . . .	1 Roll of parch- ment.

FRENCH MEASURES.

10 Millimètres	= 1 Centimètre or .39371 Eng. Inches.
10 Centimètres	= 1 Décimètre or 3.9371 „ „
10 Décimètres	= 1 Mètre or 39.371 Eng. Inches or nearly 39 $\frac{3}{8}$ Inches.
1000 Mètres	= 1 Kilomètre or 4 fur. 39 pls. 4 $\frac{5}{8}$ yds. or rather more than $\frac{3}{8}$ of a mile.
10 Kilomètres	= 6 $\frac{1}{4}$ Miles nearly.
1 Lieue or French League	= Little more than 2 $\frac{1}{2}$ Miles.
10,000 Mètres Carrés (square metres)	= 1 Hectare or nearly 2 $\frac{1}{2}$ Acres.

The French measures are either decimal parts or multiples of the mètre.

The French standard measure is the mètre; it is one ten millionth of the distance from the pole to the equator.

The standard weight is the gramme = 15.434 English grains.

FRENCH WEIGHTS.

10 Milligrammes	= 1 Centigramme or .15434 Eng. Grains.
10 Centigrammes	= 1 Decigramme or 1.5434 Eng. Grains.
10 Decigrammes	= 1 Gramme or 15.434 Eng. Grains.
1000 Grammes	= 1 Kilogramme or rather more than 2 lbs. 3 ozs. 4 drs.
100 Kilogrammes	= nearly 1 cwt. 3 qrs. 24 lbs. 5 ozs. (Eng.)
1000 Kilogrammes or 1 tonneau	= nearly 19 cwt. 2 qrs. 19 lbs. 2 ozs. (Eng.)

1 Litre = 1 $\frac{3}{4}$ Pints (English).

100 Litres or 1 Hectolitre = 22 Gallons (English).

1 English Foot = 3.05 Décimètres.

$\frac{1}{8}$ of 1 Hectare = 1 Arpent.

1 English Quart = 1.14 Litres.

1 English Gallon = 4.54 Litres.

FRENCH MONEY.

(Value in English.)

			£	s.	d.
Gold	{ Double Napoleon	= 40 Francs	=	1	13 4
	{ 1 Napoleon	= 20 Francs	=	0	16 8
	{ $\frac{1}{2}$ Napoleon	= 10 Francs	=	0	8 4
Gold Silver	{ $\frac{1}{4}$ Napoleon	= 5 Francs	=	0	4 2
Silver	1 Franc	= 20 Sous or 100 Centimes	=	0	0 10
Bronze	{ 1 Sous	= 5 Centimes	=	0	0 0 $\frac{1}{2}$
	{ 1 Centime		=	0	0 0 $\frac{1}{10}$

PRUSSIAN MONEY.

(Value in English.)

			£	s.	d.
Gold	1 Frederickstall = 11 Thalers, 20 Silbergroschen	=	1	16	0
Silver	1 Thaler = 3 Gulden	=	0	3	0
	1 Gulden = 10 Silbergroschen	=	0	1	0
	1 Halbe gulden = 2 Silbergroschen	=	0	0	6
	1 Act Halbe = 2 Silbergroschen 6 Feinye	=	0	0	3
	1 Silbergroschen = 12 Feinye, or 3 Groschen	=	0	0	1 $\frac{1}{3}$
Bronze	1 Halbe Silbergroschen = 6 Feinye	=	0	0	0 $\frac{2}{3}$
	1 Groschen = 4 Feinye	=	0	0	0 $\frac{2}{3}$
	1 Halbe Groschen = 2 Feinye	=	0	0	0 $\frac{1}{3}$
	1 Feinye	=	0	0	0 $\frac{1}{10}$

AUSTRIAN MONEY.

(Value in English.)

			£	s.	d.
Gold	1 Ducat = 5 Reinsk	=	0	8	4
Silver	1 Reinsk = 14 Kreutzer	=	0	1	8
Bronze	1 Kreutzer	=	0	0	1 $\frac{3}{4}$
	1 Centime	=	0	0	0 $\frac{1}{8}$

RUSSIAN MONEY.

(Value in English.)

			£	s.	d.
Gold	100 Gulden = 15 Roubles	=	2	10	0
	1 Ducat = 11 Roubles	=	1	16	8
Silver	1 Rouble = 6 Gulden and 40 Kopeik	=	0	3	4
	1 Gulden = 60 Kopeik	=	0	0	6
	1 Half Gulden = 30 Kopeik	=	0	0	3
Bronze	10 Groschen = 20 Kopeik	=	0	0	2
	1 Kopeik	=	0	0	0 $\frac{1}{10}$

DANISH MONEY.

(Value in English.)

			£	s.	d.
Gold	Christian d'Or	=	0	16	7
	Ducat	=	0	7	6
Silver	Rix Dollar, or 6 Marks	=	0	4	0
	Mark	=	0	0	7 $\frac{1}{2}$

SIMPLE ADDITION.

EXERCISE II.

(1) 59371 18406 20864 3654 91768 7129 <hr/>	(2) 502987 67064 213546 796101 314 9322578 <hr/>	(3) 5936978 875612 10269 7009825 342158 76972 <hr/>
(4) 1421865 370912 4264049 3562957 91802 201 <hr/>	(5) 9876453 160497 398721 19034 7542965 581325 <hr/>	(6) 80676175 1550732 56019610 4473947 901666 11210734 <hr/>
(7) 16815642 9520 532691 27892476 14631265 2596783 45230 <hr/>	(8) 13459726 9621453 732689 4275421 63124732 65309 54792465 <hr/>	(9) 441698853 37519162 599678437 4840 5128697 20304009 679821345 172564 4263721 <hr/>
(10) 447147907 36518698 90962783 59873501 967390293 109356 2962703 <hr/>	(11) 558258014 72102162 7397918 35476007 421654713 578075241 32194320 864127659 <hr/>	(12) 925682143 832563297 4327568 98526342 753291424 643263 71952875 2147397 <hr/>

SIMPLE SUBTRACTION.

EXERCISE III.

- | | | |
|---|---|--|
| (1) $\begin{array}{r} 49732146 \\ 37521034 \\ \hline \end{array}$ | (2) $\begin{array}{r} 9876587967231 \\ 7632413527011 \\ \hline \end{array}$ | (3) $\begin{array}{r} 3457824976321 \\ 934976259348 \\ \hline \end{array}$ |
|---|---|--|

$$\begin{array}{r} (4) \quad 176249348296727 \\ \quad 82497632985729 \\ \hline \end{array}$$

$$\begin{array}{r} (5) \quad 52978493862973 \\ \quad 942876043184 \\ \hline \end{array}$$

$$\begin{array}{r} (6) \quad 423298723459007321 \\ \quad 4329047898243052 \\ \hline \end{array}$$

$$\begin{array}{r} (7) \quad 21324582973200004235 \\ \quad 892457829340056897 \\ \hline \end{array}$$

$$\begin{array}{r} (8) \quad 152967842357828 \\ \quad 92876432987149 \\ \hline \end{array}$$

$$\begin{array}{r} (9) \quad 120732456782345 \\ \quad 92487638492948 \\ \hline \end{array}$$

$$\begin{array}{r} (10) \quad 16290000045000667 \\ \quad 8219400093453287 \\ \hline \end{array}$$

$$\begin{array}{r} (11) \quad 21298643259378521 \\ \quad 7348967389200523 \\ \hline \end{array}$$

$$\begin{array}{r} (12) \quad 3698765432187542364 \\ \quad 897348547829354786 \\ \hline \end{array}$$

SIMPLE MULTIPLICATION.

EXERCISE IV.

- | | |
|---------------------------|-------------------------------|
| (1) $4987256 \times 8.$ | (2) $327543 \times 5.$ |
| (3) $543784973 \times 4.$ | (4) $98765432 \times 9.$ |
| (5) $789564321 \times 7.$ | (6) $268291348753 \times 15.$ |

- | | |
|----------------------------------|---------------------------------|
| (7) 23297821516 \times 18. | (8) 724567 \times 21. |
| (9) 54871239 \times 24. | (10) 6543897263 \times 346. |
| (11) 8976342189 \times 2006. | (12) 98765432178 \times 4809. |
| (13) 189764321896 \times 8973. | (14) 8931281 \times 64325. |
| (15) 3678421 \times 40007. | (16) 84376571 \times 6355. |
| (17) 957438631 \times 8002. | (18) 487658741 \times 3654. |
| (19) 4765489 \times 4652. | (20) 873567234 \times 7005. |

SIMPLE DIVISION.

EXERCISE V.

- | | |
|-----------------------------------|--|
| (1) 89358256 \div 2. | (2) 2189235496 \div 7. |
| (3) 325749348 \div 9. | (4) 89625709 \div 15. |
| (5) 8957723 \div 18. | (6) 5955014125 \div 21. |
| (7) 261151231 \div 36. | (8) 4378921 \div 33. |
| (9) 82579321 \div 63. | (10) 5298325693 \div 54. |
| (11) 39728457 \div 72. | (12) 9294756239 \div 144. |
| (13) 15736407 \div 17. | (14) 15180775 \div 29. |
| (15) 95547408 \div 121. | (16) 12845403 \div 523. |
| (17) 3104717850 \div 3246. | (18) 89728416118 \div 50006. |
| (19) 1667818058561 \div 201001. | (20) 1703501322587532 \div 40000001. |

REDUCTION.

Reduction is the method which enables us to convert quantities from one denomination to another.

To reduce a quantity from a higher denomination.

RULE.—Multiply the highest denomination by as many of the next lower as it contains, adding to the product whatever of the lower denomination may be present; this process must be repeated till the required denomination is obtained.

Reduce £37 13s. 8 $\frac{3}{4}$ d. to farthings.

$$\begin{array}{r}
 20 \\
 \hline
 753 \text{ shillings} \\
 12 \\
 \hline
 9044 \text{ pence} \\
 4 \\
 \hline
 36179 \text{ farthings.}
 \end{array}$$

Reduce 5A. 2R. 11P. 7 yds. 5 ft. 29 in. to inches.

$$\begin{array}{r}
 4 \\
 \hline
 22 \text{ roods} \\
 40 \\
 \hline
 891 \text{ poles} \\
 30\frac{1}{4} \\
 \hline
 26737 \\
 222\frac{3}{4} \\
 \hline
 26959\frac{3}{4} \text{ yards} \\
 9 \\
 \hline
 242642\frac{3}{4} \text{ feet} \\
 144 \\
 \hline
 970597 \\
 970568 \\
 \hline
 242642 \\
 108 = \frac{3}{4} \text{ of } 144 \\
 \hline
 34940585 \text{ inches.}
 \end{array}$$

To reduce a quantity from a higher denomination to a lower.

RULE.—Divide the given quantity by the number of the next lower denomination which it contains, and annex any remainder so as to retain the denominator of the dividend; this process must be repeated till the required denomination is obtained.

Reduce 42137 farthings to pounds.

$$\begin{array}{r}
 4) 42137 \text{ farthings} \\
 12) 10534\frac{1}{4} \\
 2,0) 87.7-10 \\
 \hline
 £43 \text{ } 17s. \text{ } 10\frac{1}{4}d.
 \end{array}$$

Reduce 45673869763 inches to miles.

$$\begin{array}{r}
 12) 45673869763 \text{ inches} \\
 3) 3806155813-7 \text{ inches} \\
 1268718604-1 \text{ feet} \\
 2 \\
 \hline
 11) 2537437208 \quad \text{yds. ft. in.} \\
 4,0) 23067610,9-9 \text{ half-yds.} = 4.1.6 \quad 1.7 \\
 8) 5766902-29 \\
 \hline
 \text{fur. pls. yds. ft. in.} \\
 \text{Miles } 720862-6.29.5.0.1
 \end{array}$$

EXERCISE VI.

- (1) Reduce £1 17s. 8d. to farthings.
- (2) Reduce £17 16s. 8½d. to halfpence.
- (3) Reduce £36 19s. 11¾d. to farthings.
- (4) Reduce 5000 guineas to pence.
- (5) Reduce £1787 16s. 9d. to three-penny pieces.
- (6) Reduce 78651 guineas to halfpence.
- (7) Reduce £568326 11s. 6¾d. to farthings.
- (8) Reduce 187654 halfcrowns to farthings.
- (9) Reduce £7385924 10s. 8d. to four-penny pieces.
- (10) Reduce 500000 0s. 4½d. to farthings.
- (11) Reduce £51600 16s. 8d. to pence.
- (12) Reduce 1 qr. 2 lbs. 10 oz. 4 drs. Av. to drams.
- (13) Reduce 2 qrs. 0 lbs. 1 oz. 14 drs. Av. to drams.
- (14) Reduce 6 tons 8 cwt. 1 qr. 13 lbs. 9 oz. 3 drs. Av. to drams.
- (15) Reduce 1 ton 0 cwt. 3 qrs. 21 lbs. 9 oz. Av. to ounces.
- (16) Reduce 126 tons 19 cwt. 27 lbs. 15 oz. 14 drs. to drams.
- (17) Reduce 8765963 tons 10 cwt. 3 qrs. 20 lbs. 14 oz. to ounces.
- (18) Reduce 1 lb. 8 oz. 18 dwts. 20 grs. Troy, to grains.
- (19) Reduce 5 lbs. 7 oz. 10 dwts. 13 grs. Troy, to grains.
- (20) Reduce 175863425 lbs. 10 oz. 15 dwts. 20 grs. Troy, to grains.
- (21) Reduce 23 lbs. 7 oz. 2 drs. 1 scr. 3 grs. Ap. to grains.
- (22) Reduce 36 lbs. 7 oz. 3 drs. 1 scr. 13 grs. Ap. to grains.
- (23) Reduce 5267 lbs. 3 oz. 5 drs. 2 scr. 16 grs. Ap. to grains.
- (24) Reduce 1068574 lbs. 10 oz. 5 drs. 2 scr. 16 grs. Ap. to grains.
- (25) Reduce 1 mile 4 fur. 110 yds. 2 ft. to feet.
- (26) Reduce 25 miles 3 fur. 100 yds. 2 ft. 6 in. to inches.
- (27) Reduce 17685432 miles 3 fur. 20f. 3 yds. 1 ft. to feet.
- (28) Reduce 8 sq. miles 15A. 3R. 8P. 6 sq. yds. 8 ft. to feet.
- (29) Reduce 176458A. 1R. 20P. 20 yds. 6 ft. to feet.
- (30) Reduce 8 bus. 3 pks. 1 gal. 3 qts. 1 pt. to pints.
- (31) Reduce 35 bus. 2 pks. 0 gals. 3 qts. 1 pt. to pints.
- (32) Reduce 468759 lds. 4 qrs. 6 bus. 2 pks. 1 gal. 2 qts. 1 pt. to pints.
- (33) Reduce 5 cub. yds. 15 ft. 200 in. to cubic inches.
- (34) Reduce 53 cub. yds. 19 ft. 10 in. to cubic inches.
- (35) Reduce 73 yds. 3 qrs. 1 nail 1¼ in. to inches.
- (36) Reduce 854 yds. 2 qrs. 1 nail 1½ in. to inches.
- (37) Reduce 96543 yds. 1 qr. 0 nails 2 in. to inches.
- (38) Reduce 3 days 3 hours 28 min. 52 sec. to seconds.
- (39) Reduce 50 years 10 mo. 3 wks. 4 dys. to hours.
- (40) Reduce 3695827 years 6 mo. 3 wks. 6 dys. 0 min. 16 sec. to seconds.

EXERCISE VII.

- (1) Reduce 57643 farthings to pounds.
- (2) Reduce 8643219 farthings to pounds.
- (3) Reduce 1865431 farthings to halfcrowns.
- (4) Reduce 1865437 farthings to guineas.
- (5) Reduce 6854682 farthings to pounds.
- (6) Reduce 176548964368 farthings to pounds.
- (7) Reduce 71259403126 pence to pounds.
- (8) Reduce 600000006000 farthings to pounds.
- (9) Reduce 6954683745867 farthings to guineas.
- (10) Reduce 79432045634 halfpence to guineas.
- (11) Reduce 1427640057842 farthings to guineas.
- (12) Reduce 3654378907643 farthings to pounds.
- (13) Reduce 943167326481 pence to pounds.
- (14) Reduce 6843219004932 sixpences to guineas.
- (15) Reduce 453279634987 farthings to seven-shilling pieces.
- (16) Reduce 3749378963 farthings to halfcrowns.
- (17) Reduce 789000480 farthings to crowns.
- (18) Reduce 437895389 halfpence to crowns.
- (19) Reduce 997345387 ounces Av. to cwts.
- (20) Reduce 435679835900001 drams Av. to tons.
- (21) Reduce 4735894267 drams Av. to cwts.
- (22) Reduce 1234567890 lbs. Av. to tons.
- (23) Reduce 456789876 ounces Av. to tons.
- (24) Reduce 7643800143 drams Av. to tons.
- (25) Reduce 7378943210 drams. Av. to quarters.
- (26) Reduce 12570986403700129 grains Ap. to pounds.
- (27) Reduce 8423290057 grains Troy to pounds.
- (28) Reduce 76543189001 grains Troy to ounces.
- (29) Reduce 768426849672 grains Troy to pounds.
- (30) Reduce 3751395761 inches to furlongs.
- (31) Reduce 3401607326 inches to miles.
- (32) Reduce 468924790 inches to miles.
- (33) Reduce 4983257842 feet to leagues.
- (34) Reduce 41601764324 sq. inches to acres.
- (35) Reduce 153142300 sq. yards to acres.
- (36) Reduce 9760005473 sq. inches to acres.
- (37) Reduce 51236923567 quarts. to loads.
- (38) Reduce 123456789 seconds to years.
- (39) Reduce 14569801624 seconds to years.
- (40) Reduce 965483501468 seconds to years.

COMPOUND ADDITION.

EXERCISE VIII.

	£	s.	d.
(1)	217	16	$7\frac{1}{2}$
	109	19	$8\frac{3}{4}$
	51	3	9
	86	16	$4\frac{1}{2}$
	75	5	$11\frac{3}{4}$
	1	0	2

	£	s.	d.
(2)	783	5	$6\frac{1}{4}$
	296	2	$0\frac{1}{2}$
	102	10	$6\frac{1}{2}$
	91	6	$7\frac{3}{4}$
	60	2	1
	1	0	$7\frac{1}{2}$

	£	s.	d.
(3)	217	6	$10\frac{3}{4}$
	500	0	$0\frac{1}{4}$
	299	9	$9\frac{3}{4}$
	10	10	$10\frac{1}{4}$
	18	7	$6\frac{1}{2}$
	9	2	3

	£	s.	d.
(4)	1234	5	$6\frac{3}{4}$
	2202	10	$0\frac{1}{2}$
	391	9	$9\frac{1}{4}$
	1620	10	$1\frac{3}{4}$
	1200	2	$3\frac{3}{4}$
	110	19	$5\frac{1}{2}$

	£	s.	d.
(5)	2926	19	$8\frac{1}{4}$
	187	2	$7\frac{1}{2}$
	21	0	6
	200	10	$2\frac{1}{4}$
	111	8	$3\frac{1}{2}$
	19	2	1

	£	s.	d.
(6)	10009	6	$4\frac{1}{2}$
	29832	19	$1\frac{3}{4}$
	4620	10	$11\frac{1}{2}$
	12349	8	$2\frac{3}{4}$
	46537	10	$3\frac{1}{2}$
	9241	3	$1\frac{1}{2}$

	£	s.	d.
(7)	1345	10	$2\frac{3}{4}$
	12469	19	$3\frac{1}{2}$
	3454	8	6
	92134	6	5
	4567	3	$4\frac{1}{2}$
	2891	10	$9\frac{1}{2}$

	£	s.	d.
(8)	1534	15	$6\frac{3}{4}$
	12396	19	$7\frac{1}{4}$
	56437	1	$10\frac{1}{2}$
	6790	17	$11\frac{1}{4}$
	9098	12	$10\frac{1}{2}$
	3692	15	$8\frac{3}{4}$

	£	s.	d.
(9)	1144	15	$7\frac{1}{2}$
	177	2	$1\frac{1}{4}$
	1055	8	$9\frac{1}{4}$
	643	10	$11\frac{3}{4}$
	7488	19	$7\frac{1}{2}$
	555	14	$6\frac{3}{4}$

	£	s.	d.
(10)	1058	18	$2\frac{3}{4}$
	753	10	$11\frac{1}{2}$
	1420	8	$9\frac{3}{4}$
	78	19	$5\frac{1}{2}$
	1578	14	9
	8176	3	$10\frac{1}{2}$

	£	s.	d.
(11)	15148	17	$2\frac{1}{2}$
	10053	13	$9\frac{3}{4}$
	51687	19	$1\frac{1}{4}$
	683	17	5
	47321	0	$7\frac{1}{4}$
	15782	11	$6\frac{3}{4}$

	£	s.	d.
(12)	10445	19	$9\frac{1}{4}$
	5445	16	$7\frac{1}{2}$
	21467	18	$1\frac{3}{4}$
	41279	15	$3\frac{1}{2}$
	7878	1	$1\frac{1}{2}$
	56722	13	$11\frac{3}{4}$

	£	s.	d.
(13)	97684	15	3 $\frac{3}{4}$
	47108	9	10 $\frac{1}{2}$
	105862	11	9 $\frac{1}{4}$
	587451	18	10 $\frac{1}{4}$
	3172	15	3 $\frac{1}{2}$
	58716	10	0 $\frac{1}{2}$

	£	s.	d.
(14)	799856	19	3 $\frac{1}{2}$
	44715	16	8 $\frac{1}{4}$
	899821	15	4 $\frac{3}{4}$
	79963	18	2 $\frac{1}{2}$
	4488	15	7 $\frac{3}{4}$
	997755	10	6 $\frac{1}{2}$

	£	s.	d.
(15)	578643	11	8 $\frac{1}{4}$
	973211	17	9 $\frac{3}{4}$
	461658	18	2 $\frac{1}{2}$
	754863	10	10 $\frac{1}{2}$
	500872	17	3 $\frac{1}{4}$
	199810	9	4 $\frac{3}{4}$

	£	s.	d.
(16)	775566	15	8 $\frac{1}{4}$
	973211	17	9 $\frac{3}{4}$
	461658	18	2 $\frac{1}{2}$
	754863	10	10 $\frac{1}{2}$
	500872	17	3 $\frac{1}{4}$
	199810	9	4 $\frac{3}{4}$

	tons.	cwt.	qrs.	lbs.	oz.	drs.
(17)	2	5	2	15	10	12
	7	17	3	19	10	8
	5	19	3	17	11	9
	6	15	1	23	12	7
	7	13	2	24	13	6
	8	18	3	13	10	5

	tons.	cwt.	qrs.	lbs.	oz.	drs.
(18)	7	19	1	27	13	15
	8	12	3	21	10	10
	6	16	2	22	14	10
	7	17	1	27	11	15
	2	11	1	23	12	13
	8	10	3	24	15	15

	tons.	cwt.	qrs.	lbs.	oz.	drs.
(19)	2	2	2	14	2	13
	2	3	2	15	4	14
	9	7	3	17	3	15
	6	8	2	16	7	11
	7	9	1	18	6	10
	8	2	2	19	8	9

	oz.	dwt.	grs.
(20)	3	14	17
	7	13	19
	10	18	20
	9	19	21
	8	7	18
	7	8	11

	lbs.	oz.	dwt.	grs.
(21)	1	10	16	23
	0	11	17	21
	0	0	15	19
	1	1	12	18
	0	9	8	15
	0	7	11	13

	oz.	dwt.	grs.
(22)	9	18	22
	8	17	1
	7	15	3
	6	14	17
	4	10	18
	1	2	6

	drs.	scr.	grs.
(23)	8	1	15
	6	2	17
	5	2	19
	7	1	10
	8	0	18
	9	2	17

	oz.	drs.	scr.	grs.		oz.	drs.	scr.	grs.		qts.	pts.	gills
(24)	1	1	0	17	(25)	1	0	1	19	(26)	4	1	3
	1	2	1	15		0	7	2	18		3	1	2
	0	7	2	18		0	3	0	6		2	1	3
	1	1	0	4		0	2	0	8		2	0	2
	0	1	2	7		0	7	2	10		4	1	3
	0	4	1	0		1	1	1	7		3	0	2

	qts.	pts.	gills		qts.	pts.	gills		hrs.	min.	sec.
(27)	2	0	2	(28)	7	0	3	(29)	24	59	48
	5	1	3		5	0	2		28	46	58
	4	1	2		3	1	0		23	49	54
	3	1	1		7	1	3		1	19	17
	4	0	0		2	1	0		15	27	49
	3	1	2		3	0	2		17	39	19

	hrs.	min.	sec.		hrs.	min.	sec.		pls.	yds.	ft.	in.
(30)	36	54	58	(31)	1	59	44	(32)	30	5	2	4
	12	55	57		2	17	28		17	3	1	11
	14	22	56		14	22	44		39	4	2	9
	22	18	59		18	17	19		27	2	2	8
	4	1	7		4	43	57		11	3	2	1
	7	8	1		9	18	53		9	4	1	11

	mls.	fur.	pls.	yds.	ft.		fur.	yds.	ft.	in.		ells.	qrs.	nls.	in.
(33)	8	7	6	5	2	(34)	7	0	2	6	(35)	18	4	3	2
	7	6	13	4	2		6	3	1	7		4	3	2	1 $\frac{1}{4}$
	6	5	14	3	2		5	110	2	8		3	0	2	1
	24	7	39	5	1		4	9	2	9		7	4	3	2
	36	7	36	5	1		3	111	2	10		6	0	1	13 $\frac{3}{4}$
	11	6	3	1	2		2	7	2	11		13	1	0	0

	yds.	qrs.	nls.	in.		ells.	qrs.	nls.	in.		mls.	ac.	rd.	per.
(36)	13	3	2	1	(37)	17	0	3	2	(38)	170	73	3	39
	15	2	3	2		32	4	2	$1\frac{1}{4}$		160	73	2	1
	17	1	1	2		64	3	1	0		105	84	1	37
	19	0	1	1		32	2	0	0		104	95	0	3
	21	3	2	0		16	1	1	$1\frac{3}{4}$		130	85	1	36
	23	2	3	1		8	0	2	2		102	75	2	4
<hr/>					<hr/>					<hr/>				
<hr/>					<hr/>					<hr/>				

	mls.	ac.	yds.	ft.		ac.	yds.	ft.	in.
(39)	80	186	4839	8	(40)	639	4839	8	143
	7	280	1	7		629	4793	6	7
	60	380	4800	6		54	33	5	2
	5	480	4635	5		176	224	1	0
	40	580	220	4		345	756	6	136
	3	620	1300	3		601	1545	7	4
<hr/>					<hr/>				
<hr/>					<hr/>				

COMPOUND SUBTRACTION.

EXERCISE IX.

	£	s.	d.		£	s.	d.		£	s.	d.
(1)	46	18	10	(2)	28	1	6	(3)	107	0	$0\frac{1}{2}$
	23	17	1		26	17	8		100	10	$11\frac{1}{2}$
<hr/>				<hr/>				<hr/>			
<hr/>				<hr/>				<hr/>			
	£	s.	d.		£	s.	d.		£	s.	d.
(4)	108	3	$8\frac{1}{4}$	(5)	57	6	$10\frac{1}{2}$	(6)	178	15	$1\frac{3}{4}$
	100	7	$6\frac{3}{4}$		48	15	$2\frac{1}{4}$		158	16	$2\frac{1}{2}$
<hr/>				<hr/>				<hr/>			
<hr/>				<hr/>				<hr/>			
	£	s.	d.		£	s.	d.		£	s.	d.
(7)	46	10	$2\frac{1}{2}$	(8)	41	18	$9\frac{1}{4}$	(9)	168	2	$6\frac{1}{2}$
	18	9	$1\frac{1}{4}$		5	19	$8\frac{3}{4}$		100	7	$11\frac{3}{4}$
<hr/>				<hr/>				<hr/>			
<hr/>				<hr/>				<hr/>			

$$\begin{array}{r} \text{(10)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 155 \quad 10 \quad 5\frac{1}{2} \\ 70 \quad 18 \quad 4\frac{3}{4} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(11)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 189 \quad 0 \quad 0\frac{1}{4} \\ 99 \quad 10 \quad 11\frac{1}{2} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(12)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 427 \quad 1 \quad 4\frac{3}{4} \\ 326 \quad 19 \quad 9\frac{1}{2} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(13)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 1986 \quad 17 \quad 2\frac{3}{4} \\ 1785 \quad 19 \quad 6\frac{1}{2} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(14)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 1507 \quad 6 \quad 10\frac{1}{2} \\ 1006 \quad 17 \quad 9\frac{3}{4} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(15)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 1086 \quad 10 \quad 2\frac{1}{2} \\ 189 \quad 11 \quad 3\frac{3}{4} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(16)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 107532 \quad 19 \quad 9\frac{1}{4} \\ 103572 \quad 18 \quad 11\frac{3}{4} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(17)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 74321 \quad 18 \quad 9\frac{1}{4} \\ 60132 \quad 19 \quad 11 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(18)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 109867 \quad 10 \quad 11\frac{3}{4} \\ 100986 \quad 12 \quad 10 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(19)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 147321 \quad 15 \quad 0 \\ 60000 \quad 19 \quad 7 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(20)} \quad \begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 167892 \quad 0 \quad 7\frac{1}{4} \\ 70037 \quad 1 \quad 11\frac{3}{4} \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(21)} \quad \begin{array}{r} \text{lbs.} \quad \text{oz.} \quad \text{drs.} \quad \text{Av.} \\ 12 \quad 10 \quad 11 \\ 10 \quad 15 \quad 14 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(22)} \quad \begin{array}{r} \text{qrs.} \quad \text{lbs.} \quad \text{oz.} \quad \text{drs.} \\ 3 \quad 13 \quad 2 \quad 7 \\ 2 \quad 12 \quad 7 \quad 9 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(23)} \quad \begin{array}{r} \text{lbs.} \quad \text{oz.} \quad \text{drs.} \quad \text{Av.} \\ 15 \quad 3 \quad 9 \\ 10 \quad 7 \quad 15 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(24)} \quad \begin{array}{r} \text{oz.} \quad \text{dwts.} \quad \text{grs.} \\ 4 \quad 6 \quad 8 \\ 3 \quad 19 \quad 23 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(25)} \quad \begin{array}{r} \text{oz.} \quad \text{dwts.} \quad \text{grs.} \\ 6 \quad 19 \quad 17 \\ 3 \quad 17 \quad 23 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(26)} \quad \begin{array}{r} \text{lbs.} \quad \text{oz.} \quad \text{dwts.} \quad \text{grs.} \\ 2 \quad 2 \quad 7 \quad 1 \\ 1 \quad 8 \quad 8 \quad 2 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(27)} \quad \begin{array}{r} \text{oz.} \quad \text{drs.} \quad \text{scr.} \quad \text{grs.} \\ 1 \quad 0 \quad 1 \quad 5 \\ 6 \quad 2 \quad 7 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{(28)} \quad \begin{array}{r} \text{oz.} \quad \text{drs.} \quad \text{scr.} \quad \text{grs.} \\ 1 \quad 4 \quad 0 \quad 7 \\ 1 \quad 1 \quad 2 \quad 19 \\ \hline \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{oz. drs. scr.} \\ (29) \quad 9 \quad 7 \quad 0 \\ \quad \quad 3 \quad 5 \quad 2 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{yds. ft. in.} \\ (30) \quad 16 \quad 2 \quad 1 \\ \quad \quad 7 \quad 1 \quad 11 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{mils. fur. pls.} \\ (31) \quad 36 \quad 7 \quad 7 \\ \quad \quad 26 \quad 6 \quad 39 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{mils. fur. pls.} \\ (32) \quad 144 \quad 3 \quad 17 \\ \quad \quad 100 \quad 7 \quad 19 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{yds. qrs. nls.} \\ (33) \quad 17 \quad 2 \quad 1 \\ \quad \quad 15 \quad 1 \quad 3 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{yds. qrs. nls.} \\ (34) \quad 146 \quad 1 \quad 2 \\ \quad \quad 140 \quad 2 \quad 3 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{yds. qrs. nls.} \\ (35) \quad 246 \quad 0 \quad 1 \\ \quad \quad 236 \quad 2 \quad 3 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{ac. r. pls.} \\ (36) \quad 1240 \quad 3 \quad 17 \\ \quad \quad 1200 \quad 2 \quad 39 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{ac. r. pls.} \\ (37) \quad 1144 \quad 1 \quad 18 \\ \quad \quad 1100 \quad 3 \quad 22 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{ac. r. pls.} \\ (38) \quad 110 \quad 0 \quad 22 \\ \quad \quad 100 \quad 3 \quad 32 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{qrs. bus. pks.} \\ (39) \quad 9 \quad 3 \quad 1 \\ \quad \quad 3 \quad 7 \quad 3 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{bus. pks. gals. qts.} \\ (40) \quad 1 \quad 0 \quad 0 \quad 1 \\ \quad \quad 3 \quad 1 \quad 3 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{gals. qts. pts. gills} \\ (41) \quad 1 \quad 3 \quad 1 \quad 3 \\ \quad \quad 1 \quad 1 \quad 1 \quad 2 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{hrs. min. sec.} \\ (42) \quad 1065 \quad 44 \quad 36 \\ \quad \quad 1000 \quad 33 \quad 48 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{tons. cwt. qrs. lbs. oz. drs.} \\ (43) \quad 13 \quad 15 \quad 2 \quad 13 \quad 9 \quad 13 \\ \quad \quad 11 \quad 19 \quad 3 \quad 14 \quad 15 \quad 14 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{lbs. oz. dwts. grs.} \\ (44) \quad 3 \quad 9 \quad 13 \quad 21 \\ \quad \quad 1 \quad 11 \quad 17 \quad 23 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{lbs. oz. drs. scr. grs.} \\ (45) \quad 7 \quad 3 \quad 5 \quad 2 \quad 15 \\ \quad \quad 4 \quad 9 \quad 7 \quad 2 \quad 19 \\ \hline \hline \end{array}$$

$$\begin{array}{r} \text{mils. fur. pls. yds. ft. in.} \\ (46) \quad 2 \quad 6 \quad 13 \quad 4 \quad 2 \quad 7 \\ \quad \quad 1 \quad 4 \quad 17 \quad 3 \quad 2 \quad 10 \\ \hline \hline \end{array}$$

	lbs.	qrs.	bns.	pks.	gals.	qts.	pts.		ac.	r.	pls.	sq.yds.	sq.ft.	sq.in.
(47)	2	3	5	2	1	2	1	(48)	15	2	29	15	7	115
	1	4	7	3	1	3	1		12	3	34	11	7	132

	yrs.	mo.	wks.	dys.	hrs.	min.	sec.		cuh.yds.	ft.	in.
(49)	6	10	2	3	17	52	18	(50)	3	19	1351
	2	11	3	6	21	56	59		1	23	1700

COMPOUND MULTIPLICATION.

EXERCISE X.

- | | |
|--|--|
| (1) £46 2s. 3d. \times 2. | (2) £58 10s. 6d. \times 2. |
| (3) £49 11s. $11\frac{1}{2}$ d. \times 3. | (4) £77 18s. $9\frac{3}{4}$ d. \times 3. |
| (5) £107 18s. $10\frac{1}{2}$ d. \times 4. | (6) £157 16s. 1d. \times 4. |
| (7) £297 15s. $5\frac{3}{4}$ d. \times 5. | (8) £573 16s. 2d. \times 5. |
| (9) £642 18s. $9\frac{3}{4}$ d. \times 6. | (10) £789 10s. $11\frac{1}{2}$ d. \times 6. |
| (11) £1035 18s. $9\frac{1}{4}$ d. \times 7. | (12) £1076 16s. 1d. \times 7. |
| (13) £1085 2s. $6\frac{1}{2}$ d. \times 8. | (14) £2755 16s. 7d. \times 8. |
| (15) £2175 5s. $5\frac{1}{2}$ d. \times 9. | (16) £3177 3s. $6\frac{1}{2}$ d. \times 9. |
| (17) £1777 15s. $5\frac{3}{4}$ d. \times 10. | (18) £4757 18s. 9d. \times 10. |
| (19) £4993 16s. $3\frac{3}{4}$ d. \times 11. | (20) £5884 7s. 6d. \times 11. |
| (21) £6774 18s. $8\frac{3}{4}$ d. \times 12. | (22) £8877 15s. 5d. \times 12. |
| (23) £43 11s. $10\frac{1}{2}$ d. \times 20. | (24) £76 2s. $2\frac{1}{4}$ d. \times 22. |
| (25) £89 7s. 10d. \times 33. | (26) £101 17s. $6\frac{1}{2}$ d. \times 36. |
| (27) £114 16s. $3\frac{3}{4}$ d. \times 44. | (28) £44 2s. 6d. \times 66. |
| (29) £26 2s. $11\frac{1}{4}$ d. \times 88. | (30) £100 10s. $10\frac{3}{4}$ d. \times 96. |
| (31) £20 4s. 6d. \times 100. | (32) £50 10s. 6d. \times 108. |
| (33) £70 8s. $3\frac{1}{2}$ d. \times 110. | (34) £93 6s. 1d. \times 120. |
| (35) £110 11s. 10d. \times 144. | (36) £120 10s. 3d. \times 200. |

EXERCISE XI.

- | | |
|--|---|
| (1) £144 6s. $6\frac{3}{4}$ d. \times 250. | (2) £4 10s. 2d. \times 280. |
| (3) £10 10s. 7d. \times 290. | (4) £20 3s. $3\frac{3}{4}$ d. \times 300. |
| (5) £32 6s. 2d. \times 320. | (6) £46 10s. $4\frac{1}{4}$ d. \times 370. |
| (7) £5 17s. 4d. \times 17. | (8) £84 5s. $9\frac{1}{2}$ d. \times 23. |
| (9) £7 19s. $11\frac{3}{4}$ d. \times 29. | (10) £109 8s. $6\frac{3}{4}$ d. \times 53. |
| (11) £10 10s. $10\frac{1}{4}$ d. \times 147. | (12) £10 10s. $0\frac{1}{4}$ d. \times 149. |

- (13) £209 19s. 0 $\frac{3}{4}$ d. \times 1729. (14) £2 2s. 2 $\frac{1}{4}$ d. \times 31.
 (15) £7 7s. 7 $\frac{3}{4}$ d. \times 1009. (16) £24 5s. 6d. \times 111.
 (17) £7 6s. 5 $\frac{3}{4}$ d. \times 19. (18) £7 9s. 11 $\frac{3}{4}$ d. \times 122.

EXERCISE XII.

- (1) 18 lbs. 6 oz. 16 dwts. 8 grs. \times 83.
 (2) 64 lbs. 6 oz. 10 dwts. 16 grs. \times 164.
 (3) 2 lbs. 2 oz. 2 dwts. 2 grs. \times 256.
 (4) 24 lbs. 2 oz. 2 drs. 1 scr. 10 grs. \times 288.
 (5) 2 oz. 4 drs. 2 scr. 4 grs. \times 79.
 (6) 2 lbs. 2 oz. 2 drs. 2 scr. \times 243.
 (7) 21 yds. 2 qrs. 2 nls. \times 216.
 (8) 6 ells 2 qrs. 1 nl. 1 in. \times 85.
 (9) 2 yds. 3 qrs. 3 nls. 1 $\frac{1}{2}$ in. \times 169.
 (10) 3 yrs. 11 mon. 2 wks. 6 dys. \times 73.
 (11) 7 mon. 1 wk. 3 dys. 12 hrs. \times 245.
 (12) 2 wks. 6 dys. 5 hrs. 40 min. \times 168.
 (13) 5 tons 4 cwt. 3 qrs. 4 lbs. \times 786.
 (14) 3 cwt. 2 qrs. 14 lbs. 6 oz. \times 247.
 (15) 3 qrs. 14 lbs. 8 oz. 8 drs. \times 162.
 (16) 3 gals. 3 qts. 1 pt. 3 gills \times 473.
 (17) 3 lds. 4 qrs. 7 bus. 3 pks. \times 285.
 (18) 4 qrs. 3 bus. 2 pks. 1 gal. \times 288.
 (19) 122 cub. yds. 13 ft. 1191 in. \times 897.
 (20) 21 cub. yds. 13 ft. 508 in. \times 774.
 (21) 14 cub. yds. 13 ft. 12 in. \times 770.
 (22) 4 mls. 5 fur. 33 pls. 1 yd. \times 876.
 (23) 7 fur. 39 pls. 2 yds. 1 ft. \times 994.
 (24) 37 pls. 4 yds. 2 ft. 10 in. \times 125.
 (25) 20 sq. yds. 4 ft. 36 in. \times 367.
 (26) 3R. 39P. 3 yds. \times 459.
 (27) 4A. 2R. 20P. \times 5007.

COMPOUND DIVISION.

EXERCISE XIII.

- (1) £33 17s. 6d. \div 2. (2) £5040302 19s. 9d. \div 3.
 (3) £705 15s. 8d. \div 4. (4) £930 16s. 6 $\frac{3}{4}$ d. \div 5.
 (5) £704 11s. 4 $\frac{1}{2}$ d. \div 6. (6) £60 10s. 5d. \div 7.
 (7) £5047 6s. 4d. \div 8. (8) £5030 8s. 4 $\frac{1}{2}$ d. \div 9.
 (9) £77 17s. 8 $\frac{1}{2}$ d. \div 10. (10) £77 11s. 11d. \div 11.

- | | |
|--------------------------------|-------------------------------|
| (11) £44 17s. 0d. ÷ 12. | (12) £77 0s. 0d. ÷ 12. |
| (13) £244 10s. 5d. ÷ 10. | (14) £29 17s. 8½d. ÷ 10. |
| (15) £45452 3s. 9d. ÷ 100. | (16) £77995 14s. 7d. ÷ 100. |
| (17) £101 11s. 9d. ÷ 21. | (18) £133 12s. 0d. ÷ 16. |
| (19) £654 13s. 4d. ÷ 64. | (20) £998 15s. 1d. ÷ 121. |
| (21) £350 8s. 9d. ÷ 63. | (22) £51230 10s. 0d. ÷ 40. |
| (23) £236 16s. 8d. ÷ 56. | (24) £423 6s. 0d. ÷ 144. |
| (25) £3600 14s. 7d. ÷ 100. | (26) £4500 7s. 6d. ÷ 110. |
| (27) £7564 16s. 9d. ÷ 132. | (28) £23546 11s. 3d. ÷ 300. |
| (29) £3919 4s. 0d. ÷ 96. | (30) £3808 9s. 3d. ÷ 54. |
| (31) £3127 1s. 8d. ÷ 1000. | (32) £1272 0s. 1¼d. ÷ 125. |
| (33) £29553 7s. 1½d. ÷ 729. | (34) £80558 15s. 6d. ÷ 1331. |
| (35) £159548 8s. 0d. ÷ 1584. | (36) £450743 8s. 9d. ÷ 900. |
| (37) £1074 1s. 10½d. ÷ 810. | (38) £90 7s. 6d. ÷ 36. |
| (39) £253 10s. 0d. ÷ 45. | (40) £10508 16s. 0d. ÷ 512. |
| (41) £145092 13s. 6d. ÷ 441. | (42) £11525 10s. 3½d. ÷ 343. |
| (43) £1299062 10s. 0d. ÷ 1000. | (44) £100598 19s. 2d. ÷ 1000. |
| (45) £7531583 6s. 8d. ÷ 10000. | (46) £141052 1s. 8d. ÷ 10000. |

EXERCISE XIV.

- (1) 49 lbs. 8 oz. 5 dwts. Troy ÷ 5.
- (2) 120 lbs. 8 oz. 13 dwts. Troy ÷ 7.
- (3) 10 tons 19 cwt. 3 qrs. 12 lbs. ÷ 3.
- (4) 71 tons 19 cwt. 3 qrs. 19 lbs. ÷ 9.
- (5) 101 lbs. 1 oz. 5 drs. 1 scr. Ap. ÷ 8.
- (6) 73 lbs. 5 oz. 3 drs. 1 scr. Ap. ÷ 14.
- (7) 92 miles 3 fur. 8 f. ÷ 16.
- (8) 163 yds. 2 ft. 9 in. ÷ 21.
- (9) 611A. 2R. 20P. ÷ 28.
- (10) 195A. 1R. 26P. ÷ 54.
- (11) 462 yards 0 qrs. 0 nails ÷ 96.
- (12) 329 cub. yds. 26 cub. ft. 1548 cub. in. ÷ 100.
- (13) 352 bus. 2 pks. 0 gals. 0 qts. ÷ 120.
- (14) 950 qrs. 5 bus. 0 pks. 0 gals. 0 qts. ÷ 240.
- (15) 13 mo. 1 wk. 4 dys. 0 hrs. ÷ 225.
- (16) 10 mo. 2 wks. 3 dys. 0 hrs. ÷ 324.

EXERCISE XV.

- | | |
|--------------------------|--------------------------|
| (1) £89 5s. 0d. ÷ 51. | (2) £462 6s. 8d. ÷ 73. |
| (3) £289 13s. 4d. ÷ 79. | (4) £565 16s. 8d. ÷ 97. |
| (5) £826 17s. 6d. ÷ 315. | (6) £1574 8s. 0d. ÷ 123. |
| (7) £1284 7s. 6d. ÷ 137. | (8) £716 2s. 6d. ÷ 17. |

- | | |
|---|-------------------------------------|
| (9) £2173 5s. 10d. ÷ 43. | (10) £239445 0s. 0d. + 3400. |
| (11) £32878 2s. 6d. ÷ 4500. | (12) £1793962 11s. 8d. + 17860. |
| (13) £113812 10s. 0d. + 36000. | (14) £1100 10s. 7½d. ÷ 78. |
| (15) £866 0s. 4d. + 104. | (16) £3632 19s. 1½d. + 154. |
| (17) £2117 15s. 6¾d. + 123. | (18) £672 17s. 3d. + 54. |
| (19) £19514 4s. 5d. + 203. | (20) £371 2s. 6¾d. + 279. |
| (21) 2592 lbs. 2 oz. 5 dwts. + 711. | (22) 813 tons 16 cwt. 3 qrs. + 917. |
| (23) 773 miles 2 furlongs 39f. 1 yd. 2 ft. 7 in. + 317. | |
| (24) 834A. 1R. 2P. 16 yds. 0 ft. 26 in. + 523. | |
| (25) £28 17s. 9½d. + £4 2s. 6½d. | (26) £10 1s. 9¼d. ÷ £2 0s. 4¼d. |
| (27) £36 7s. 1½d. + £6 1s. 2¼d. | (28) £6916 10s. 5d. + £406 17s. 1d. |

MISCELLANEOUS EXAMPLES.

EXERCISE XVI.

- (1) What will be the value of 721 marks, when a mark is worth £0 13s. 4d.?
- (2) A workman's wages are £1 4s. 6d. per week; he pays a rent of 2s. 6d. per week, and incidental expenses amount to 2s. per day. What money will he have saved at the end of a month?
- (3) A gentleman going on a journey takes with him a £100; his different railway tickets amount to £28 9s. 6d., hotel expenses £20 12s. 9d.; he loses three £10 notes and offers a reward of £5 for their recovery. The person who found them received the reward. What money will he have left?
- (4) A person sells 277 sheep at £2 13s. 0d. per head; what does he receive for them?
- (5) A gentleman's annual income is £735 10s. 0d. per year, he pays an income tax of £12 5s. 2d., his other rates amount to £28 9s. 6d.; what will be his net annual income?
- (6) From five billions seven hundred and eighty-two millions two hundred and forty-six, take two billions one hundred and sixty-three thousand nine hundred and seventy-two millions seven hundred and fifty-nine thousand six hundred and eighty-nine.
- (7) Make out a bill for the following articles: 24 yards of calico at 9½d. per yard, 10 yards of black cloth at 10s. 6d. per yard, 4 pairs of kid gloves at 2s. 6d. per pair, 2 shawls at £2 13s. 0d. each.
- (8) An organist's salary is 30 guineas a year. His return ticket weekly costs him 3s. 4d.; his Sunday's dinner 1s. 5½d. What is his clear annual income?

(9) The rent of a house is 150 guineas a year. The poor rates £23 12s. 2½d. a year. The lighting rate £2 11s. 6½d. a year. All these are paid out of £500; what is the change?

(10) A doctor is owed £574 12s. 10d. Of this the bad debts amount to £85 11s. 11d. His medicines cost him £24 15s. 4d.; and his horse £29 13s. 8½d. a year. What is his clear yearly income?

(11) A carpenter earns 4s. 9d. a day. His lodgings cost him 6s. 10d. a week, his food £1 11s. 7½d. a month (of 4 weeks). He has a holiday of three weeks in the year. How much will he save yearly?

(12) A person buys 450 sheep at £42 7s. 0d. per score. He keeps them six months, for which time their keeping costs £73 15s. 10d. In this time 67 sheep died; the rest are sold at £2 1s. 6d. each. What does he gain or lose?

(13) 30 steel pens weigh 1 oz. avoirdupois; Mr. Gillot makes every year 184 tons of steel into pens: what are the pens worth at ¼d. each?

(14) A tradesman's household expenses amount to £2 17s. 10½d. a week, he lays out in goods £23 16s. 7½d. a calendar month, and he takes in the shop £411 17s. 9d. in the year. What does he lay by at the year's end?

(15) A banker has in his drawer 16 piles of sovereigns, each containing 13; his clerk steals them, and puts in their place 16 piles, each consisting of 12 farthings with a sovereign at the top, to prevent detection. How much does the banker lose?

(16) A tobacconist weighs and sells 368 ounces of tobacco (as he supposes), but discovers afterwards that his weight marked '1 oz.' really weighs 1½ oz. He sells the tobacco at the rate of 6s. 8d. a lb.; how much does he gain or lose by the false weight?

(17) There are in a house 10 gas burners, each consuming 10 feet of gas an hour. If they are used 8 hours a day, what will be the cost of the gas used in 1 month (4 weeks) at 7s. 6d. per 1000 cubic feet?

(18) If a penny piece weighs 1 oz. avoirdupois, what will be the worth of 2 tons 1 cwt. 0 qrs. 4 lbs. 9 ozs. of penny pieces?

(19) A schoolmaster has 11 boys paying 4¾d. a week; 17 at 2½d.; 23 at 1¼d.; and 5 free. He gives 6 weeks holiday in the year; what are the annual payments?

(20) A person buys a horse for 55 guineas; keeps it 37 weeks at a cost of 7s. 10½d. a week, and sells it for £52. He might have hired a horse for 15s. 8d. a week, clear. By how much is one plan more profitable than the other?

(21) A gentleman has 37 houses bringing in £35 a year each; repairs cost him £75 11s. 10½d. a year. For 29 of them he pays a ground rent of £1 14s. 8d. each. What is his clear yearly income?

(22) A farmer's expenses are £672 17s. 7½d., his year's rent £1 2s. 7d. an acre, for a farm of 237 acres. His year's receipts are £1201 2s. What is his net income?

(23) A person's income is £2000 a year; his average daily expenses £2 18s. 10½d. What does he save in two years?

(24) A tradesman makes a bill for £30 3s. 10½d.; his figures are so bad that he mistakes all his 5's for 3's. There are in this bill 14 figure 5's in the pence, 17 in the shillings, and 1 in the £'s. How much does he lose.

(25) A draper buys 37 yards of silk at 7s. 10½d. a yard, and sells it at 8s. 11½d. a yard. He also buys 43 yards of velvet at 16s. 9¾d. a yard, which he sells at 16s. 5½d. a yard. What does he lose or gain on the two transactions?

(26) A party of 19 people go out to spend the day. Their whole expenses are £9 10s. 2½d. Two of the party run away without paying; what have the rest to pay each?

(27) A gentleman sets out from Broxbourne Station to Glasgow, having £10 to pay his travelling expenses; they are as follows: train to London, 3s. 4d.; cab, 2s.; expenses at Euston Hotel, 7s. 10d.; book, 1s. 3d.; ticket to Glasgow, £4 1s. 7d.; dinner, 2s. 6d.; lost at the station, 4 groats; incidental expenses, 8s. 3½d. In paying for the cab he gave half-a-sovereign instead of sixpence. What money had he when he reached his destination?

(28) A gentleman's coachman overturns his carriage which cost £176 15s. 7d.; the repairs to the windows cost £12 17s. 3½d., to the body of the carriage, £27 13s. 2½d., and two new lamps, £1 15s. 10d. each. He then gives the coach builder 18 guineas and the repaired carriage for a new one. The coach builder sells the repaired carriage for 120 guineas; what does he gain, and what does the gentleman's second carriage cost him (supposing it to be exactly like the first)?

(29) A workman's wages are £1 7s. 10d. a week, his rent is 2s. 3d. a week, his board 13s. 5½d. a week; what has he left at the end of the year?

(30) A gentleman leaves £2999 16s. 0d. to be equally divided by his executors among all the poor in the parish over 70 years of age. There are 238 persons over 70; but 79 of these are not poor; what will each poor person receive?

(31) The duty on malt is £1 1s. 8d. per quarter; a person pays £576 6s. 8d. duty; on what quantity was it paid?

(32) Divide £70 among 4 persons, so that one may have £5 10s. 0d. more than the others.

(33) How many guineas, half-guineas, crowns, florins, and three-penny pieces (an equal number of each) are there in £31.

(34) The distance from Hoddesdon to London is 17 miles; how long will it take a person to accomplish the journey, supposing he walks 3 miles, 3 furlongs, 8 poles per hour?

(35) What will be the cost of labour for erecting a building, upon which 10 carpenters, 12 bricklayers, and 17 labourers are employed for 3 weeks, and receive respectively 4s. 3d., 3s. 9d., and 2s. 6d. per day?

(36) A grocer buys 2 cwt. of tea for £33 16s. 2½d., and sells it for £36 16s. 10½d.; what does he gain in selling 1 lb. weight?

(37) 3 cwt. 2 qrs. 14 lbs. of coffee cost £37 18s. 9½d. This is retailed at 2s. 1½d. per lb.; what is gained or lost by the whole business?

(38) Turn 17 yds. 3 qrs. 1 nl. into English ells, and then multiply by 58.

(39) 75 hogsheads of sugar weigh, altogether, 11 tons 7 lbs. 10 oz.; each hogshead weighs 18 lbs. 9 oz. 11 drs. What is the net weight?

(40) A man's income is £530 a year; his weekly expenses are £10 3s. 7½d.; how much does he save or go beyond his income in 5 years?

(41) A linendraper buys 3 pieces of silk, each containing 49 yards, for £47 12s. 9½d. He sells it for 6s. 7½d. a yard; what does he gain or lose?

(42) A carpenter's weekly wages are 31s. 5½d.; he spends 19s. 10½d. on his board and lodging weekly; his clothes cost £8 7s. 10½d. a year; what does he save yearly?

(43) A person employs 85 workmen; he pays £1 7s. 8½d. a week to each of 34 men; 23 more receive 18s. 2½d. a week each; the rest get, each, 14s. 2d. a week; what does the employer pay weekly for wages?

(44) Gunpowder contains $\frac{3}{4}$ of its weight of saltpetre; saltpetre costs 5s. 7½d. a cwt. If the sulphur and charcoal, for 16 tons 12 cwt. of gunpowder, cost £29 14s. 8½d., what will the saltpetre cost?

(45) A grocer, during 2 months, buys and sells the following articles: He buys 3 chests (each 64 lbs.) of tea, at 2s. 6d. per lb., and retails the same at 3s. 4d. per lb.; 2 hogsheads of sugar, each weighing 160 lbs., at 4d. per lb., and retails the same at 5½d. per lb.; and the other sundries which he buys amount to £216 15s. 7d., and sells them for £270 13s. 6d.; what does he gain in a year (buying and selling, on an average, as he did in the above two months).

(46) A person buys goods to the amount of £48 5s. 0d., and he wants to pay his bill in an equal quantity of sovereigns, half-sovereigns, seven-shilling pieces, crowns, halfcrowns, florins, shillings, sixpences, and three-penny pieces; what equal number of each will he have to pay?

(47) A landlord has 47 cottages let at 2s. 6d. per week, 30 at 3s. 4d., 15 at 5s., and 4 houses at £50 per year; his taxes amount to, on the

first lot of cottages, £5 1s. 10d., on the second, £4 6s. 8d., on the third, £3 5s. 0d., on the 4 houses, £3 6s. 8d.; repairs on the different houses amount to £314 17s. 11d. per year; but on account of high prices, he lets his tenants off £112 16s. 7d.; what money did he gain by his cottages and houses that year?

(48) From three hundred and twenty-four billions, five hundred and sixty-seven thousand millions, thirty-four thousand two hundred and ninety-six inches, take one hundred and thirty-nine billions, seven hundred and eighty-four thousand three hundred and seventy-six millions, two hundred and seventy-eight thousand four hundred and fifty-seven inches, and reduce the remainder to miles, furlongs, &c.

(49) What is the income of a person who pays £49 15s. 8d. income tax, at 4d. in the £?

(50) Divide £1332 7s. 6d. amongst 12 men, 14 women, and 20 children, so that each man may have three times as much as a woman, and a woman four times as much as a child.

VULGAR FRACTIONS.

A Fraction is a part or parts of unity, as $\frac{1}{2}$, $\frac{2}{7}$. In the first instance unity is divided into 2 parts and 1 taken, and in the second instance unity is divided into 7 parts and 6 taken. From this it will be seen that a fraction is the simplest form of expressing division, when the divisor is not contained an exact number of times in the dividend.

In a vulgar fraction the figure below the line is called the **Denominator**, and the figure above the line is called the **Numerator**.

A Proper Fraction is one whose numerator is less than the denominator, as $\frac{1}{2}$, $\frac{2}{7}$.

An Improper Fraction is one whose numerator is equal to or greater than the denominator, as $\frac{4}{2}$, $\frac{9}{7}$; every whole number can also be expressed as an improper fraction, as $\frac{5}{1}$.

A Mixed Number is composed of a whole number and a fraction, as $6\frac{2}{3}$, $15\frac{1}{2}$.

A Compound Fraction is a fraction of a fraction, as $\frac{2}{3}$ of $\frac{3}{4}$, $4\frac{1}{2}$ of $\frac{5}{8}$ of $7\frac{2}{3}$.

A Complex Fraction is a fraction where either the numerator or denominator are fractions, or both numerator and denominator are fractions ; as $\frac{2}{3\frac{1}{4}}$, $\frac{1\frac{2}{3}}{4}$, $\frac{\frac{3}{4}}{\frac{5}{6}}$, $\frac{3\frac{3}{4}}{5\frac{2}{3}}$.

GREATEST COMMON MEASURE.

The **G. C. M.** is the greatest number that will divide two or more numbers without leaving a remainder. It is principally used in reducing fractions to their lowest terms.

To find the greatest common measure of two numbers.

RULE.—Divide the greater by the less and the divisor by the remainder, and so on continually till there is no remainder. The last divisor will be the G. C. M.

The reason of this rule cannot be properly explained without the assistance of algebra ; and as every intelligent pupil now studies algebra, we must refer him to that subject for the explanation.

Find the G. C. M. of 6509 and 7889.

$$\begin{array}{r}
 6509 \overline{) 7889} \quad (1 \\
 \underline{6509} \\
 1380 \overline{) 6509} \quad (4 \\
 \underline{5520} \\
 989 \overline{) 1380} \quad (1 \\
 \underline{989} \\
 391 \overline{) 989} \quad (2 \\
 \underline{782} \\
 207 \overline{) 391} \quad (1 \\
 \underline{207} \\
 184 \overline{) 207} \quad (1 \\
 \underline{184} \\
 23 \overline{) 184} \quad (8 \\
 \underline{184} \\
 \dots
 \end{array}$$

G. C. M. 23.

EXERCISE XVII.

Find the G. C. M. of:—

- | | |
|--------------------------|--------------------------|
| (1) 1534 and 1770. | (2) 45369 and 44943. |
| (3) 961 and 1550. | (4) 1369 and 1591. |
| (5) 1763 and 4857. | (6) 1681 and 1517. |
| (7) 5041 and 5680. | (8) 6889 and 7553. |
| (9) 7921 and 8900. | (10) 7569 and 8265. |
| (11) 8281 and 9373. | (12) 9409 and 9991. |
| (13) 10201 and 10807. | (14) 10609 and 4223. |
| (15) 10700 and 11449. | (16) 11881 and 12644. |
| (17) 12321 and 12987. | (18) 80089 and 82353. |
| (19) 95161 and 2362461. | (20) 85849 and 293000. |
| (21) 233289 and 483000. | (22) 113569 and 337000. |
| (23) 73441 and 30081. | (24) 619369 and 7870000. |
| (25) 966289 and 4915000. | |

To reduce a mixed number to an improper fraction.

RULE.—Multiply the whole number by the denominator of the fraction, and add in the numerator for the new numerator; the denominator remains unaltered.

$$\begin{aligned} \text{(E.g.) } 4\frac{3}{8} &= 4 \times 8 + 3 = \frac{35}{8}. \\ 15\frac{7}{8} &= 15 \times 8 + 7 = \frac{127}{8}. \end{aligned}$$

EXERCISE XVIII.

Reduce to improper fractions:—

- | | | | | |
|----------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|
| (1) $5\frac{2}{3}$. | (2) $10\frac{1}{5}$. | (3) $35\frac{2}{3}$. | (4) $81\frac{1}{11}$. | (5) $43\frac{4}{15}$. |
| (6) $13\frac{3}{17}$. | (7) $121\frac{1}{21}$. | (8) $14\frac{1}{133}$. | (9) $987\frac{6}{25}$. | (10) $88\frac{7}{11}$. |
| (11) $97\frac{21}{71}$. | (12) $156\frac{513}{114}$. | (13) $793\frac{16}{183}$. | (14) $693\frac{31}{100}$. | (15) $560\frac{441}{1000}$. |
| (16) $48\frac{73}{83}$. | (17) $96\frac{24}{54}$. | (18) $89\frac{16}{17}$. | (19) $189\frac{17}{189}$. | (20) $234\frac{21}{178}$. |
| (21) $118\frac{71}{100}$. | (22) $634\frac{21}{500}$. | (23) $189\frac{15}{103}$. | (24) $586\frac{17}{118}$. | (25) $869\frac{182}{180}$. |

To reduce an improper fraction to a whole or mixed number.

RULE.—Divide the numerator by the denominator, the quotient will be the whole number; if there should be a remainder that will form the numerator of the fractional part of the mixed number, the denominator remaining unaltered.

$$\text{(E.g.) } \frac{49}{7} = 7, \frac{49}{5} = 9\frac{4}{5}.$$

EXERCISE XIX.

Reduce to whole or mixed numbers:—

- | | | | | |
|------------------------------|----------------------------|----------------------------|---------------------------|-----------------------------|
| (1) $\frac{34}{7}$. | (2) $\frac{84}{9}$. | (3) $\frac{111}{10}$. | (4) $\frac{330}{8}$. | (5) $\frac{179}{11}$. |
| (6) $\frac{432}{21}$. | (7) $\frac{463}{21}$. | (8) $\frac{5046}{71}$. | (9) $\frac{2918}{64}$. | (10) $\frac{2076}{500}$. |
| (11) $\frac{100894}{1000}$. | (12) $\frac{2227}{91}$. | (13) $\frac{10320}{104}$. | (14) $\frac{7926}{89}$. | (15) $\frac{5551}{55}$. |
| (16) $\frac{5943}{333}$. | (17) $\frac{3784}{60}$. | (18) $\frac{443}{41}$. | (19) $\frac{6273}{111}$. | (20) $\frac{66500}{1100}$. |
| (21) $\frac{22678}{500}$. | (22) $\frac{25674}{816}$. | (23) $\frac{28643}{512}$. | (24) $\frac{18765}{80}$. | (25) $\frac{28457}{5000}$. |

To reduce a fraction to its lowest terms.

A fraction may at once be reduced to its lowest terms by dividing both numerator and denominator by the G. C. M., or by dividing both numerator and denominator by a common factor that may be found by inspection.

Reduce $\frac{7568}{5604}$ to its lowest terms:—

G. C. M. = 176; dividing by 176 we have

$$176) \frac{7568}{5604} = \frac{43}{32}.$$

Reduce $\frac{378}{882}$ to its lowest terms:—

$$3) \frac{378}{882} = 7) \frac{126}{264} = 6) \frac{12}{22} = \frac{6}{11}$$

EXERCISE XX.

Reduce to their lowest terms:—

- | | | |
|--|------------------------------------|--|
| (1) $\frac{2250}{2528}$. | (2) $\frac{870}{1746}$. | (3) $\frac{1947}{5124}$. |
| (4) $\frac{1088}{1322}$. | (5) $\frac{1872}{2036}$. | (6) $\frac{8784}{43976}$. |
| (7) $\frac{1110}{1321}$. | (8) $\frac{2295}{2448}$. | (9) $\frac{22945}{48732}$. |
| (10) $\frac{2365}{37841}$. | (11) $\frac{13113}{13536}$. | (12) $\frac{6075}{8808}$. |
| (13) $\frac{2745}{3568}$. | (14) $\frac{1715}{3678}$. | (15) $\frac{65219}{86071}$. |
| (16) $\frac{4596}{7377}$. | (17) $\frac{1509}{6536}$. | (18) $\frac{7498}{11520}$. |
| (19) $\frac{171820}{180068}$. | (20) $\frac{101031}{108972}$. | (21) $\frac{36662}{48884}$. |
| (22) $\frac{122221}{133332}$. | (23) $\frac{24442}{28888}$. | (24) $\frac{26679}{119427}$. |
| (25) $\frac{108243}{165213}$. | (26) $\frac{62208}{103680}$. | (27) $\frac{232432}{359148}$. |
| (28) $\frac{281075}{609178}$. | (29) $\frac{90597}{114231}$. | (30) $\frac{182250}{488000}$. |
| (31) $\frac{37139}{482807}$. | (32) $\frac{169244}{177408}$. | (33) $\frac{1678985}{1713220}$. |
| (34) $\frac{2296321}{2887680}$. | (35) $\frac{5232155}{6597068}$. | (36) $\frac{675684}{1866131}$. |
| (37) $\frac{857142}{959999}$. | (38) $\frac{11565212}{13886058}$. | (39) $\frac{20202521822}{48091564408}$. |
| (40) $\frac{241174769798}{217864271132}$. | | |

To reduce a compound fraction to a simple one.

RULE.—Multiply all the numerators together for a new numerator, and all the denominators together for a new denominator, or, if possible, divide any denominator by any numerator, or by a factor common to both.

$$\frac{2}{3} \text{ of } \frac{5}{7} = \frac{10}{21}.$$

$$\frac{1}{2} \text{ of } \frac{1}{2} \text{ of } 3\frac{1}{3} = \frac{1}{2} \text{ of } \frac{4}{5} \text{ of } \frac{10}{3} = \frac{4}{3} = 1\frac{1}{3}.$$

The reason of this rule is evident, for $\frac{1}{2}$ of $\frac{1}{2}$ must be $\frac{1}{4}$, or by rule $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$.

EXERCISE XXI.

Express as simple fractions :—

- (1) $\frac{1}{2}$ of $\frac{5}{8}$ of $1\frac{3}{4}$.
- (2) $\frac{1}{4}$ of $\frac{3}{8}$ of 8.
- (3) $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$.
- (4) $1\frac{1}{4}$ of $3\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{7}{11}$.
- (5) $\frac{2}{3}$ of $\frac{5}{8}$ of $\frac{9}{7}$ of $\frac{7}{8}$.
- (6) $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$.
- (7) $2\frac{2}{3}$ of $\frac{3}{11}$ of $\frac{11}{12}$ of $\frac{2}{3}$.
- (8) $3\frac{4}{11}$ of $\frac{5}{37}$ of $1\frac{1}{11}$ of $10\frac{1}{12}$.
- (9) $4\frac{1}{2}$ of $5\frac{1}{3}$ of $\frac{2}{34}$ of $\frac{5}{33}$ of 12.
- (10) $2\frac{2}{3}$ of $5\frac{2}{3}$ of $3\frac{2}{4}$ of $\frac{1}{86}$ of $\frac{2}{3}$.
- (11) $5\frac{2}{3}$ of $7\frac{1}{3}$ of $\frac{30}{77}$ of $\frac{1}{18}$ of $2\frac{5}{8}$ of $\frac{3}{34}$.
- (12) $2\frac{5}{7}$ of $3\frac{2}{3}$ of $\frac{1}{18}$ of $3\frac{6}{11}$ of $5\frac{12}{13}$ of $\frac{5}{68}$.
- (13) $7\frac{1}{5}$ of $4\frac{2}{3}$ of $\frac{27}{34}$ of $\frac{15}{16}$ of $5\frac{1}{3}$ of $2\frac{1}{2}$.
- (14) $5\frac{1}{20}$ of $6\frac{2}{3}$ of $5\frac{1}{2}$ of $5\frac{1}{2}$ of $2\frac{1}{18}$.
- (15) $\frac{4}{11}$ of $4\frac{5}{7}$ of $9\frac{1}{11}$ of $\frac{11}{56}$ of $6\frac{2}{3}$ of $\frac{7}{17}$.
- (16) $8\frac{2}{3}$ of $1\frac{5}{18}$ of $\frac{1}{37}$ of $4\frac{2}{3}$ of $\frac{9}{58}$ of $5\frac{1}{3}$.
- (17) $9\frac{2}{3}$ of $\frac{5}{8}$ of $\frac{7}{8}$ of $2\frac{1}{2}$ of $\frac{8}{381}$ of $8\frac{1}{2}$ of $\frac{5}{77}$ of $13\frac{1}{2}$.
- (18) $\frac{12}{14}$ of $\frac{7}{22}$ of $11\frac{2}{3}$ of $\frac{20}{143}$ of $102\frac{5}{13}$ of $\frac{1}{8}$ of $\frac{4}{7}$.
- (19) $3\frac{5}{7}$ of $2\frac{2}{3}$ of $\frac{35}{52}$ of $\frac{4}{5}$ of $\frac{5}{12}$ of $12\frac{2}{3}$.
- (20) $\frac{1}{18}$ of $5\frac{3}{7}$ of $3\frac{2}{11}$ of $6\frac{5}{13}$ of $\frac{1}{14}$ of $5\frac{5}{8}$ of $1\frac{1}{2}$.
- (21) $4\frac{7}{13}$ of $3\frac{1}{13}$ of $\frac{13}{44}$ of $\frac{2}{50}$ of $5\frac{5}{8}$ of $\frac{2}{9}$ of $3\frac{2}{3}$.
- (22) $7\frac{1}{3}$ of $\frac{12}{24}$ of $\frac{3}{28}$ of $3\frac{2}{3}$ of $3\frac{5}{7}$ of $3\frac{2}{3}$ of $2\frac{2}{3}$.

LEAST COMMON MULTIPLE.

The Least Common Multiple is the least number into which two or more numbers will divide without leaving a remainder.

Required to find the L. C. M. of 4, 9, 12, 16, 18, 24.

$$\begin{array}{r}
 2) \cancel{4} . \cancel{8} . \cancel{12} . 16 . 18 . 24 \\
 \hline
 3) 8 . 9 . 12 \\
 \hline
 4) 8 . 3 . 4 \\
 \hline
 2 . 3 . 1
 \end{array}$$

Here we may strike out 4, 9, 12 because they are factors of 16, 18, 24; therefore whatever is the L. C. M. of 16, 18, 24 must be the L. C. M. of 4, 9, 12.

If we were to multiply the remaining numbers, 16, 18, 24, together, that would be a common multiple, as all these numbers would divide into it without leaving a remainder; but it would not be the least, as 16, 18, 24 have a common factor 2; as this is common to all it need not be repeated more than once, for it is evident that $2 \times 8 \times 9 \times 12$ is divisible by 16, 18, 24, but this is not the L. C. M., as 9 and 12 have a common factor 3, which need not be repeated more than once, for it is evident that $2 \times 3 \times 8 \times 3 \times 4$ is divisible by 16, 18, 24, but still this is not the L. C. M., for 8 and 4 have the common factor 4, which need not be repeated more than once, therefore we have for the L. C. M. $2 \times 3 \times 4 \times 2 \times 3 = 144$, and this is divisible by 16, 18, 24, for $2 \times 4 \times 2 = 16 \times 3 \times 3 = 144$; $2 \times 3 \times 3 = 18 \times 4 \times 2 = 144$; and $2 \times 3 \times 4 = 24 \times 2 \times 3 = 144$.

This process may be much simplified by dividing in the first instance by a number made up of factors which are divisible into two or more of the numbers. We may divide by the number 24 at once, for one of its factors, 8, will divide 16, the factor 6 will divide 18, and 24 divides 24.

$$\begin{array}{r}
 24) \cancel{4} . \cancel{8} . \cancel{12} . 16 . 18 . 24 \\
 \hline
 2 . 3 . 1
 \end{array}$$

Therefore the L. C. M. is $24 \times 2 \times 3 = 144$.

RULE.—Set down the numbers in a line, first strike out all numbers that are factors of the others, then by inspection find a number that has factors divisible into the remaining numbers.

$$36) 3. 4. 12. 18. 24. 27. 30. 36. 48. 72$$

$$7. 3. 5. 1. 4. 2$$

$$36 = 18 \times 2 = 12 \times 3 = 9 \times 4 = 6 \times 6.$$

$$36 \times 7 \times 3 \times 5 \times 4 = 15120 = \text{L. C. M.}$$

$$24) 12. 15. 16. 18. 20$$

$$1. 5. 2. 3. 4$$

$$24 = 2 \times 12 = 6 \times 4 = 3 \times 8.$$

$$24 \times 5 \times 2 \times 3 = 720 = \text{L. C. M.}$$

EXERCISE XXII.

Find the L. C. M. of

- | | |
|---|------------------------------------|
| (1) 12, 16. | (2) 15, 25. |
| (3) 9, 12, 18. | (4) 5, 35, 7. |
| (5) 9, 12, 16, 20. | (6) 7, 9, 21, 63. |
| (7) 8, 6, 4, 12. | (8) 4, 11, 22, 33. |
| (9) 10, 12, 25, 36. | (10) 12, 15, 20, 26, 30. |
| (11) 9, 18, 36, 72, 144. | (12) 11, 22, 44, 88, 176. |
| (13) 13, 48, 26, 12, 16. | (14) 7, 15, 21, 28, 35, 42, 49. |
| (15) 9, 12, 15, 16, 18, 30, 60. | (16) 28, 35, 45, 84, 90. |
| (17) 5, 15, 17, 20, 35, 40. | (18) 8, 16, 20, 24, 30, 32, 40. |
| (19) 8, 36, 72, 108, 120. | (20) 2, 19, 25, 38, 95. |
| (21) 9, 36, 72, 96, 108. | (22) 6, 25, 36, 40, 54, 60, 90. |
| (23) 12, 16, 18, 24, 30, 36, 44, 50. | (24) 2, 5, 6, 15, 18, 28, 42, 63. |
| (25) 7, 16, 28, 32, 42, 48, 63, 72. | (26) 19, 6, 9, 16, 36, 38, 48, 57. |
| (27) 4, 8, 9, 12, 16, 18, 20, 24, 36, 48, 63. | |
| (28) 9, 10, 36, 45, 54, 81, 72, 90, 108. | |
| (29) 3, 9, 27, 36, 54, 126, 180. | |
| (30) 7, 21, 28, 35, 49, 63, 77, 84. | |
| (31) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13. | |
| (32) 9, 16, 18, 24, 30, 36, 48, 40. | |
| (33) 45, 16, 18, 24, 56, 72, 96, 108. | |
| (34) 15, 18, 36, 45, 90, 105. | |
| (35) 18, 24, 32, 40, 45, 60. | |
| (36) 12, 28, 36, 45, 72, 108, 54. | |

(37) 15, 20, 45, 60, 75, 100, 125, 160.

(38) 16, 20, 28, 32, 48, 72, 96, 144.

(39) 30, 40, 12, 56, 60, 75, 108, 144, 150.

(40) 16, 24, 40, 56, 72, 80, 96, 100.

To reduce fractions to a least common denominator.

RULE.—Find the L. C. M. of all the denominators, which must be divided by the denominator of each fraction to find a multiple for the numerator. Reduce $\frac{2}{3}$, $\frac{1}{4}$, $\frac{5}{6}$, $\frac{17}{18}$ to their least common denominator. L. C. M.=36, which divided by the respective denominators gives 12, 9, 6 and 2;

$$\therefore \frac{2}{3} \times \frac{12}{12} = \frac{24}{36}; \quad \frac{1}{4} \times \frac{9}{9} = \frac{9}{36}; \quad \frac{5}{6} \times \frac{6}{6} = \frac{30}{36}; \quad \text{and} \quad \frac{17}{18} \times \frac{2}{2} = \frac{34}{36}.$$

The truth of this rule is evident: it is simply multiplying both numerator and denominator by a number which will produce the common denominator. It may be expressed as follows:

$$\frac{2 \times 12, 1 \times 9, 5 \times 6, 17 \times 2}{36} = \frac{24, 9, 30, 34}{36}.$$

EXERCISE XXIII.

Reduce to their least common den^r:—

- | | | |
|---|---|---|
| (1) $\frac{1}{2}, \frac{2}{3}, \frac{7}{10}, \frac{5}{8}$. | (2) $\frac{3}{4}, \frac{2}{5}, \frac{4}{6}, \frac{5}{7}$. | (3) $\frac{1}{2}, \frac{3}{5}, \frac{7}{8}, \frac{5}{10}$. |
| (4) $\frac{2}{3}, \frac{1}{10}, \frac{3}{20}, \frac{1}{15}$. | (5) $\frac{2}{11}, \frac{3}{22}, \frac{15}{17}, \frac{1}{24}$. | (6) $\frac{2}{3}, \frac{5}{12}, \frac{7}{10}, \frac{5}{22}, \frac{11}{24}$. |
| (7) $\frac{5}{6}, \frac{4}{10}, \frac{21}{30}, \frac{5}{12}, \frac{1}{8}$. | (8) $\frac{2}{3}, \frac{5}{10}, \frac{11}{32}, \frac{1}{7}, \frac{13}{12}$. | (9) $\frac{2}{3}, \frac{1}{11}, \frac{14}{33}, \frac{17}{50}, \frac{13}{25}, \frac{1}{168}$. |
| (10) $\frac{11}{12}, \frac{9}{10}, \frac{13}{12}, \frac{2}{3}, \frac{13}{18}, \frac{7}{20}$. | (11) $\frac{1}{10}, \frac{5}{10}, \frac{7}{24}, \frac{8}{35}, \frac{9}{40}, \frac{11}{48}$. | |
| (12) $\frac{1}{10}, \frac{2}{25}, \frac{38}{50}, \frac{23}{45}, \frac{11}{33}, \frac{1}{240}$. | (13) $\frac{2}{7}, \frac{9}{28}, \frac{13}{30}, \frac{19}{40}, \frac{43}{60}, \frac{91}{100}$. | |
| (14) $\frac{1}{10}, \frac{15}{25}, \frac{2}{5}, \frac{12}{40}, \frac{51}{70}, \frac{23}{100}$. | (15) $\frac{5}{7}, \frac{6}{35}, \frac{17}{40}, \frac{11}{50}, \frac{19}{60}, \frac{91}{100}$. | |

ADDITION OF FRACTIONS.

RULE.—Reduce to a common denominator and add the numerators. If there are mixed numbers add the whole numbers by themselves and reduce the fractions to a common denominator and add the numerators. If there

are compound fractions reduce them to simple fractions before applying the rule.

$$\frac{3}{4} + \frac{5}{8} + \frac{7}{8} = \frac{18+20+21}{24} = \frac{59}{24} = 2\frac{11}{24};$$

$$2\frac{3}{4} + 3\frac{1}{4} + 5\frac{7}{8} = 10 + \frac{24+9+28}{8} = 10\frac{61}{8} = 11\frac{25}{8};$$

$$(\frac{2}{3} \text{ of } \frac{3}{5}) + (3\frac{1}{2} \text{ of } 2\frac{3}{4} \text{ of } \frac{3}{12}) + (\frac{7}{8} \text{ of } \frac{4}{5} \text{ of } 3\frac{3}{4})$$

$$= \frac{2}{5} + 2 + 2\frac{5}{8} = 4 + \frac{16+15}{24} = 4\frac{31}{24} = 5\frac{7}{24}.$$

EXERCISE XXIV.

Find the value of

- | | |
|--|--|
| (1) $\frac{1}{2} + \frac{2}{3} + \frac{3}{4} + \frac{4}{5}$. | (2) $\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6}$. |
| (3) $\frac{2}{3} + \frac{3}{4} + \frac{4}{5} + \frac{5}{6}$. | (4) $\frac{1}{2} + \frac{7}{8} + \frac{3}{4} + 4\frac{1}{2} + \frac{5}{6}$. |
| (5) $\frac{9}{18} + \frac{1}{2} + \frac{11}{20} + \frac{3}{5} + \frac{5}{6}$. | (6) $\frac{5}{18} + \frac{7}{18} + \frac{9}{20} + \frac{11}{20}$. |
| (7) $1\frac{1}{2} + \frac{1}{3} + 1\frac{1}{4} + \frac{11}{21} + \frac{13}{28} + \frac{31}{168}$. | (8) $3\frac{1}{2} + \frac{1}{18} + \frac{17}{20} + 2\frac{13}{24} + \frac{31}{240}$. |
| (9) $4\frac{5}{8} + \frac{9}{8} + 2\frac{5}{16} + \frac{7}{8} + 1\frac{1}{4}$. | (10) $4\frac{3}{4} + 2\frac{11}{24} + \frac{16}{21} + \frac{9}{28} + \frac{1}{43}$. |
| (11) $4\frac{1}{3} + 1\frac{2}{3} + 2\frac{5}{9} + \frac{10}{21} + \frac{10}{9}$. | (12) $2\frac{3}{4} + 1\frac{3}{20} + 4\frac{1}{18} + 6\frac{1}{18} + 1\frac{1}{2}$. |
| (13) $\frac{1}{18} + \frac{10}{20} + \frac{5}{24} + \frac{13}{30} + 1\frac{23}{40}$. | (14) $1\frac{2}{3} \text{ of } 4\frac{1}{2} + \frac{5}{6} + 1\frac{1}{2}$. |
| (15) $\frac{4}{11} \text{ of } 5\frac{1}{2} + 3\frac{2}{3} \text{ of } 6$. | (16) $7\frac{1}{2} \text{ of } 1\frac{1}{3} + \frac{2}{3} \text{ of } 5\frac{1}{2}$. |
| (17) $\frac{1}{24} + \frac{5}{8} + \frac{5}{12} + 1\frac{1}{4} + 2\frac{1}{2}$. | (18) $\frac{1}{7} + 1\frac{1}{3} + \frac{3}{14} + 1\frac{1}{2} + \frac{5}{7}$. |
| (19) $\frac{7}{15} + 2\frac{1}{3} + \frac{4}{5} + \frac{2}{3} \text{ of } \frac{7}{15} + \frac{1}{25}$. | (20) $\frac{1}{15} \text{ of } \frac{9}{18} + \frac{1}{11} \text{ of } 5\frac{1}{2} + \frac{2}{20} \text{ of } 6\frac{3}{5}$. |
| (21) $\frac{2}{3} \text{ of } 3\frac{1}{2} + \frac{4}{15} \text{ of } 3\frac{3}{4} + \frac{11}{15}$. | (22) $\frac{1}{2} + \frac{1}{3} + 2\frac{1}{3} + 6\frac{1}{2} + 3$. |
| (23) $\frac{13}{14} + \frac{1}{2} \text{ of } 3\frac{3}{4} + \frac{1}{7} \text{ of } 5\frac{1}{2}$. | (24) $\frac{11}{18} + \frac{1}{2} \text{ of } 3\frac{3}{4} \text{ of } 9 + 6\frac{2}{25}$. |
| (25) $\frac{13}{24} + \frac{1}{25} \text{ of } 4\frac{1}{2} \text{ of } 8\frac{6}{18} + \frac{9}{18}$. | (26) $\frac{11}{18} + \frac{7}{11} \text{ of } 5\frac{1}{2} \text{ of } 1\frac{1}{2} \text{ of } \frac{4}{11} + \frac{23}{22}$. |
| (27) $\frac{13}{18} \text{ of } 3\frac{1}{2} + \frac{5}{8} \text{ of } 2\frac{1}{2} + \frac{11}{25}$. | (28) $\frac{4}{18} + \frac{7}{14} \text{ of } 3\frac{1}{2} + \frac{7}{11} \text{ of } 3\frac{3}{4} \text{ of } 1\frac{1}{2}$. |
| (29) $\frac{1}{18} \text{ of } 3\frac{1}{4} + \frac{11}{18} + \frac{5}{11} \text{ of } 4\frac{1}{2} \text{ of } 3\frac{2}{3} + \frac{13}{24}$. | |
| (30) $\frac{1}{18} \text{ of } 3\frac{3}{4} \text{ of } \frac{13}{18} + \frac{9}{20} + 1\frac{2}{3} \text{ of } \frac{5}{7} \text{ of } \frac{7}{12}$. | |
| (31) $5\frac{1}{2} \text{ of } 3\frac{3}{11} \text{ of } 1\frac{1}{5} \text{ of } \frac{1}{25} + 12\frac{3}{5} + \frac{256}{25} + 6\frac{2}{3} \text{ of } 7\frac{1}{2} \text{ of } \frac{1}{3} \text{ of } 6\frac{2}{15} + \frac{7}{10} \text{ of } 1\frac{1}{2} + 3\frac{3}{4} + \frac{241}{40}$. | |
| (32) $9\frac{3}{7} \text{ of } \frac{7}{11} \text{ of } \frac{1}{2} \text{ of } 4\frac{1}{2} + 10\frac{5}{6} \text{ of } \frac{18}{10} \text{ of } \frac{7}{10} + \frac{266}{25} + 10\frac{1}{5} \text{ of } 1\frac{7}{10} \text{ of } \frac{4}{5}$. | |

SUBTRACTION OF FRACTIONS.

RULE.—Reduce the fractions as in addition, but subtract instead of add the numerators; when you have to subtract from a whole number convert one of the whole numbers into a fraction with a denominator the same

as the fraction to be subtracted; this plan must also be adopted when the fraction to be subtracted is greater than the one to be subtracted from.

$$\frac{7}{8} - \frac{5}{8} = \frac{21-20}{24} = \frac{1}{24};$$

$$5 - 3\frac{5}{8} = 4\frac{8}{8} - 3\frac{5}{8} = 1\frac{3}{8};$$

$$4\frac{1}{2} - 2\frac{7}{8} = 4\frac{4}{8} - 2\frac{7}{8} = 3\frac{12}{8} - 2\frac{7}{8} = 1\frac{5}{8};$$

$$2\frac{3}{8} \text{ of } 1\frac{3}{4} - \frac{5}{8} \text{ of } 1\frac{1}{2} = 4\frac{3}{8} - \frac{5}{8} = 3\frac{15}{8} - 1\frac{4}{8} = 3\frac{11}{8}.$$

EXERCISE XXV.

Find the value of

- (1) $\frac{3}{4} - \frac{2}{8}$; $\frac{5}{6} - \frac{4}{9}$; $\frac{1}{2} - \frac{1}{3}$. (2) $\frac{1}{3} - \frac{2}{7}$; $1\frac{7}{10} - \frac{3}{10}$; $\frac{5}{7} - \frac{1}{2}$.
 (3) $1\frac{1}{8} - \frac{2}{3}$; $\frac{7}{10} - \frac{2}{3}$; $1\frac{10}{11} - 1\frac{13}{12}$. (4) $1\frac{2}{3} - \frac{7}{10}$; $9\frac{2}{11} - 1\frac{7}{11}$; $3\frac{5}{8} - 2\frac{1}{2}$.
 (5) $13 - \frac{9}{11}$; $27\frac{1}{18} - 20\frac{5}{6}$; $4\frac{3}{7} - \frac{51}{175}$. (6) $17\frac{5}{8} - 12\frac{4}{8}$; $9\frac{1}{7} - 1\frac{11}{14}$; $65\frac{2}{9} - 48\frac{1}{2}$.
 (7) $2\frac{1}{2} - (\frac{1}{12} \text{ of } 2\frac{5}{11} \text{ of } 3\frac{2}{3})$; $(\frac{5}{8} \text{ of } 1\frac{1}{12} \text{ of } 1\frac{1}{2}) - \frac{5}{12}$. (8) $3\frac{1}{2} - (\frac{10}{11} \text{ of } \frac{1}{7} \text{ of } 4\frac{1}{2})$.
 (9) $19\frac{1}{12} - 2\frac{1}{2} + 4\frac{1}{3} + 1\frac{1}{2}$. (10) $(1\frac{2}{7} \text{ of } 3\frac{2}{3} \text{ of } \frac{7}{12}) - \frac{11}{12}$.
 (11) $(\frac{2}{3} \text{ of } 1\frac{5}{6} \text{ of } 1\frac{1}{2} \text{ of } 1\frac{7}{8}) - (\frac{2}{3} \text{ of } \frac{25}{8} \text{ of } 2\frac{1}{2} \text{ of } \frac{3}{4})$.
 (12) $2\frac{1}{2} - (\frac{2}{3} \text{ of } 5\frac{2}{3} \text{ of } \frac{2}{7}) + 2\frac{5}{8} + 2\frac{1}{8} + (\frac{33}{27} \text{ of } \frac{235}{264})$.
 (13) $20\frac{23}{28} - (\frac{11}{20} \text{ of } \frac{7}{5} \text{ of } 7\frac{2}{17} \text{ of } 2\frac{1}{7} \text{ of } 1\frac{1}{33})$.
 (14) $17\frac{7}{13} - 7\frac{2}{3} + (2\frac{2}{3} \text{ of } 6\frac{1}{3} \text{ of } \frac{1}{28} \text{ of } 1\frac{7}{11}) + (1\frac{1}{6} \text{ of } 1\frac{1}{3} \text{ of } \frac{1}{5})$.
 (15) $10\frac{2}{3} - \frac{11}{24} - 1\frac{7}{10} + (1\frac{1}{8} \text{ of } 1\frac{3}{4} \text{ of } \frac{8}{9}) + \frac{3}{7} + (\frac{2}{3} \text{ of } \frac{1}{2} \text{ of } 3\frac{2}{3} \text{ of } 1\frac{1}{12})$.
 (16) $(\frac{5}{7} \text{ of } 4\frac{1}{3} \text{ of } \frac{7}{12} \text{ of } 4\frac{1}{4} \text{ of } \frac{3}{28} \text{ of } 1\frac{1}{2}) + \frac{23}{28} + 10\frac{7}{12} + 17\frac{3}{8} - 3\frac{5}{24}$.
 (17) $1\frac{3}{11} + \frac{2}{3} + 1\frac{5}{7} - (\frac{11}{15} \text{ of } 15\frac{3}{4} \text{ of } \frac{16}{33} \text{ of } \frac{2}{7})$.
 (18) $\frac{13}{150} + \frac{2}{3} - (\frac{1}{15} \text{ of } \frac{7}{18} \text{ of } 2\frac{1}{27} \text{ of } 3\frac{1}{3} \text{ of } 5\frac{1}{2} \text{ of } \frac{45}{22}) + 3\frac{7}{8} + 1\frac{1}{2} + 9\frac{5}{8} + 3\frac{5}{24} - (1\frac{1}{2} \text{ of } 19\frac{1}{8} \text{ of } \frac{1}{2}) - 3\frac{5}{24}$.
 (19) $(1\frac{6}{19} \text{ of } 8\frac{13}{18} \text{ of } \frac{17}{10} \text{ of } 19\frac{17}{21} \text{ of } 7\frac{5}{7} \text{ of } 1\frac{1}{4} \text{ of } \frac{49}{168} \text{ of } \frac{1}{18}) - (6\frac{6}{7} + 2\frac{1}{7} \text{ of } 4\frac{2}{3} + \frac{5}{14} + 1\frac{5}{7})$.
 (20) $9\frac{2}{3} + 1\frac{5}{27} + \frac{7}{9} - (14\frac{2}{3} \text{ of } 1\frac{7}{18} \text{ of } \frac{2}{9} \text{ of } 1\frac{13}{28}) + \frac{11}{30} + \frac{7}{24} + (2\frac{1}{2} \text{ of } 20\frac{7}{12} \text{ of } 1\frac{5}{16} \text{ of } 1\frac{1}{29}) - (2\frac{5}{8} + 6\frac{2}{3} + 2\frac{1}{18})$.

MULTIPLICATION OF FRACTIONS.

The rule for the multiplication of fractions is precisely the same as the rule for reducing compound fractions to simple ones, e.g., $\frac{1}{3} \times \frac{3}{4} = \frac{1}{4}$; $\frac{3}{4} \times 1 = \frac{3}{4}$; $\therefore \frac{3}{4}$ multiplied by the $\frac{1}{3}$ of 1 must be $\frac{1}{3}$ of $\frac{3}{4}$, or $\frac{1}{4}$.

$$4\frac{2}{3} \times \frac{1}{20} \times 6\frac{2}{3} \times 2\frac{2}{3} \times \frac{9}{24} = \frac{14}{3} \times \frac{1}{40} \times \frac{47}{7} \times \frac{20}{8} \times \frac{1}{24} = \frac{1}{8}.$$

EXERCISE XXVI.

- (1) $\frac{7}{8} \times \frac{12}{13} \times \frac{16}{7}$; $\frac{6}{19} \times \frac{117}{21} \times \frac{42}{3}$; $\frac{8}{13} \times \frac{1}{9} \times \frac{17}{20}$.
 (2) $11\frac{1}{7} \times 1\frac{1}{13} \times \frac{5}{12}$; $\frac{3}{8}$ of $9 \times \frac{4}{15}$; $2\frac{1}{12} \times \frac{9}{20} \times 1\frac{1}{5}$.
 (3) $4\frac{5}{12} \times \frac{15}{17} \times \frac{18}{9}$; $\frac{5}{16} \times 1\frac{3}{20}$ of $1\frac{1}{3} \times 2\frac{6}{23}$; $3\frac{5}{24} \times \frac{3}{10}$ of $6\frac{2}{7}$ of $1\frac{3}{23}$.
 (4) $\frac{15}{22} \times 4\frac{13}{20} \times 1\frac{6}{19} \times 1\frac{9}{35}$; $\frac{9}{10} \times \frac{3}{8} \times 4\frac{2}{5} \times 1\frac{4}{11} \times \frac{5}{9}$; $3\frac{7}{8} \times \frac{5}{8}$ of $1\frac{10}{11} \times 2\frac{2}{3} \times 1\frac{5}{8} \times \frac{7}{18}$.
 (5) $9\frac{9}{7}$ of $1\frac{5}{11} \times \frac{7}{8} \times 2\frac{9}{5} \times \frac{5}{13} \times \frac{3}{10}$; $1\frac{1}{32} \times \frac{6}{18} \times 4\frac{2}{3} \times \frac{3}{7} \times 5\frac{1}{4} \times 1\frac{5}{7}$.
 (6) $\frac{9}{12}$ of $10\frac{2}{3} \times 6\frac{2}{7} \times 1\frac{1}{2} \times \frac{55}{25} \times \frac{5}{22}$; $\frac{50}{22} \times 1\frac{2}{3} \times \frac{4}{5} \times \frac{35}{25} \times \frac{7}{15} \times 2\frac{2}{3} \times 1\frac{1}{7} \times 12\frac{2}{3}$
 $\times 2\frac{1}{4} \times \frac{1}{25}$.
 (7) $2\frac{4}{12} \times 7\frac{2}{3} \times \frac{5}{18} \times 1\frac{15}{23} \times \frac{20}{31} \times \frac{161}{176} \times 2\frac{2}{3} \times \frac{5}{12} \times 13\frac{12}{28} \times \frac{5}{20}$; $4\frac{1}{2} \times \frac{12}{25}$ of $11\frac{7}{8}$
 $\times \frac{21}{22} \times \frac{35}{25} \times 1\frac{22}{23}$ of $\frac{9}{13} \times 1\frac{2}{3}$ of $8\frac{2}{3}$.
 (8) $\frac{2}{3} \times 3\frac{1}{2} \times \frac{5}{14} \times 3\frac{1}{3} \times 9\frac{6}{11} \times \frac{42}{19} \times 2\frac{4}{13} \times 7\frac{3}{10} \times \frac{5}{14} \times \frac{64}{72} \times \frac{122}{10} \times \frac{11}{25}$; $1\frac{9}{15} \times \frac{6}{18}$
 $\times 1\frac{2}{20} \times \frac{52}{25} \times \frac{7}{9} \times \frac{17}{20}$ of $1\frac{1}{2} \times 6\frac{2}{7} \times 1\frac{11}{12} \times 17\frac{2}{3} \times \frac{3}{49}$ of $1\frac{1}{24} \times 2\frac{15}{28}$.

DIVISION OF FRACTIONS.

RULE.—Invert the divisor and multiply.

Ex. $\frac{3}{4} \div \frac{3}{5} = \frac{3}{4} \times \frac{5}{3} = \frac{5}{4} = 1\frac{1}{4}$.

The reason of this rule may be best explained by working a few simple examples.

$1 \div 1 = 1$. $1 \div \frac{1}{2}$ must be $= 2$, for if the divisor be four times less, the quotient will be four times greater; if 1 be divided by $\frac{2}{3}$ the quotient will be $\frac{3}{2}$, or three times less than if divided by $\frac{1}{2}$; from this we see that the quotient is always obtained by inverting the divisor and multiplying, for what holds good for 1 will be equally true for quantities less than 1.

Complex Fractions properly come under the head of Division, for, as before explained, $\frac{1}{2}$ is nothing more than $1 \div 2$, consequently $\frac{\frac{3}{4}}{\frac{5}{6}} = \frac{3}{4} \div \frac{5}{6} = \frac{3}{4} \times \frac{6}{5} = \frac{9}{10}$;

$$\frac{3\frac{2}{3} \text{ of } 3\frac{2}{3}}{2\frac{1}{2} \text{ of } 2\frac{1}{2}} = \frac{11}{3} \div \frac{5}{2} = \frac{11}{3} \times \frac{2}{5} = \frac{22}{15} = 1\frac{7}{15};$$

$$\frac{4\frac{3}{4} - 2\frac{1}{4}}{6\frac{1}{2} + 2\frac{1}{2}} = \frac{2}{8} \div \frac{9}{4} = \frac{2}{8} \times \frac{4}{9} = \frac{1}{9};$$

$$4\frac{3}{4} - 2\frac{1}{4} = 3\frac{2}{4} = 3\frac{1}{2} = 3\frac{24}{48} - 2\frac{7}{24} = 1\frac{17}{24} = \frac{55}{24};$$

$$6\frac{1}{2} + 2\frac{1}{2} = 8 + \frac{1}{2} + \frac{1}{2} = 8 + \frac{7+2}{14} = 8\frac{9}{14} = \frac{121}{14};$$

$$\frac{4}{7} + \frac{1}{2} = \frac{8+7}{14} = \frac{15}{14}; \quad \frac{5}{7} - \frac{1}{2} = \frac{10-7}{14} = \frac{3}{14};$$

$$\left(\frac{55}{28} \times \frac{14}{121}\right) + \left(\frac{15}{14} \times \frac{14}{3}\right) = \frac{55}{28} \times \frac{14}{121} \times \frac{14}{14} \times \frac{3}{14} = \frac{1}{22}.$$

EXERCISE XXVII.

- (1) $3 \div \frac{2}{3}$; $2\frac{1}{2} \div 1\frac{3}{4}$; $1\frac{1}{3} \div 1\frac{1}{2}$; $\frac{3}{4} \div 3$; $\frac{2}{3} \div \frac{4}{5}$; $2\frac{2}{3} \div 1\frac{1}{2}$; $\frac{35}{24} \div \frac{7}{16}$; $5\frac{1}{2} \div 2\frac{3}{4}$.
- (2) $6\frac{2}{3} \div 10$; $8\frac{2}{3} \div 3\frac{1}{2}$; $15\frac{5}{8} \div 18\frac{3}{4}$; $23 \div 3\frac{2}{3}$; $9\frac{4}{5} \div 1\frac{5}{12}$; $12\frac{3}{8} \div 6\frac{3}{10}$; $21\frac{2}{15} \div 16\frac{2}{15}$; $13\frac{2}{15} \div 7\frac{2}{15}$.
- (3) $\frac{5}{12}$ of $1\frac{4}{15} \div 5\frac{1}{15}$ of $\frac{3}{4}$; $1\frac{5}{8}$ of $\frac{9}{25} \div 3\frac{1}{2}$ of $\frac{2}{14}$; $2\frac{2}{11}$ of $2\frac{2}{11} \div 1\frac{7}{11}$ of $2\frac{1}{11}$; $3\frac{2}{5}$ of $2\frac{7}{10} \div 3\frac{2}{5}$ of $\frac{15}{15}$.
- (4) $\frac{2}{7}$ of $5\frac{1}{2}$ of $\frac{1}{12} \div \frac{15}{16}$ of $2\frac{2}{3}$; $8\frac{1}{2}$ of $\frac{1}{20} \div 3\frac{1}{21}$ of $1\frac{7}{28}$ of 7 ; $\frac{7}{11}$ of $1\frac{4}{11}$ of $2\frac{1}{11}$; $1\frac{1}{21}$ of $1\frac{7}{8}$ of $\frac{7}{5}$; $1\frac{1}{25}$ of $47\frac{2}{3}$ of $7\frac{1}{11}$ of $\frac{1}{10} \div 1\frac{21}{10}$ of $1\frac{21}{10}$.
- (5) $10\frac{2}{7}$ of $4\frac{2}{15}$ of $5\frac{7}{10}$ of $4\frac{2}{15} \div 1\frac{1}{12}$ of $1\frac{4}{25}$ of $4\frac{1}{2}$ of $4\frac{1}{2}$ of 11 ; $4\frac{2}{3}$ of $4\frac{7}{12}$ of $\frac{2}{3}$ of $2\frac{2}{15}$ of $\frac{3}{4} \div 1\frac{15}{16}$ of $1\frac{5}{16}$ of $3\frac{1}{16}$ of $1\frac{1}{16}$.
- (6) $3\frac{7}{16}$ of $15\frac{1}{16}$ of $9\frac{7}{16}$ of $24\frac{3}{16}$ of $\frac{200}{113} \div \frac{63}{78}$ of $5\frac{2}{11}$ of $2\frac{20}{147}$ of $1\frac{1}{15}$ of $1\frac{1}{17}$ of $47\frac{1}{2}$; $\frac{18}{4\frac{1}{2}}$; $\frac{72}{13\frac{2}{3}}$.
- (7) $\frac{17\frac{1}{2}}{2\frac{2}{3}}$; $\frac{16\frac{2}{3}}{4\frac{1}{15}}$; $\frac{1\frac{1}{2}}{3\frac{7}{16}}$; $\frac{10\frac{5}{7}}{1\frac{1}{14}}$; $\frac{5\frac{2}{11}}{\frac{54}{53}}$; $\frac{31\frac{2}{24}}{3\frac{2}{5}}$; $\frac{18\frac{2}{3}}{4\frac{2}{11}}$.
- (8) $\frac{9}{16}$; $\frac{2\frac{5}{12}}{1\frac{1}{12}}$; $\frac{3\frac{31}{36}}{8\frac{1}{6}}$; $\frac{4\frac{2}{27}}{2\frac{1}{14}}$; $\frac{4\frac{53}{62}}{1\frac{61}{121}}$; $\frac{1\frac{49}{58}}{1\frac{71}{83}}$; $\frac{12\frac{2}{12}}{1\frac{19}{35}}$; $\frac{5\frac{13}{18}}{2\frac{1}{18}}$.
- (9) $\frac{33}{2\frac{1}{2}}$ of $2\frac{1}{2}$; $\frac{12\frac{2}{3}}$ of $1\frac{2}{3}$; $\frac{27\frac{1}{2}}{2\frac{1}{2}}$ of $1\frac{1}{2}$; $\frac{8\frac{2}{3}}$ of $1\frac{4}{3}$; $\frac{1\frac{2}{3}}$ of $2\frac{3}{11}$; $\frac{1\frac{2}{3}}$ of $1\frac{1}{3}$.
- (10) $\frac{5\frac{1}{2}}{3\frac{1}{2}}$ of $7\frac{2}{3}$ of $5\frac{5}{6}$; $\frac{20}{3\frac{1}{2} \div 7\frac{7}{9}}$; $\frac{47}{2\frac{1}{2} \div 5\frac{5}{6} \div 1\frac{1}{2}}$; $\frac{1\frac{2}{3}}{1\frac{1}{3} \div 1\frac{2}{4} \div \frac{1}{16}}$.
- (11) $\frac{7\frac{5}{8} \div 22\frac{2}{24}}{16\frac{7}{11} \div 6\frac{2}{3}}$; $\frac{22\frac{2}{4} - 17\frac{1}{12}}{1\frac{1}{18} \text{ of } 5\frac{1}{2} \text{ of } 3\frac{1}{2}}$; $\frac{35\frac{7}{12} - 2\frac{1}{10}}{7\frac{1}{12} \div \frac{1}{8} \div 21\frac{5}{12} \div 3\frac{5}{8}}$; $\frac{5\frac{1}{3} \div 4\frac{2}{3} \div \frac{1}{12} \div \frac{7}{27}}{2\frac{1}{12} \text{ of } \frac{22}{111} \text{ of } 35\frac{1}{2} \text{ of } \frac{1}{8}}$.
- (12) $\frac{4}{6 - \frac{4}{2 + \frac{2}{3}}}$; $\frac{5}{7 + \frac{5}{3 + \frac{2}{4}}}$; $\frac{1\frac{1}{2} \div \frac{4}{3} \div 2\frac{1}{3}}{5\frac{1}{2} \div 7\frac{1}{12} \div \frac{2}{36}}$; $\frac{1\frac{1}{2} \div \frac{7}{27}}{4 \text{ of } 1\frac{3}{4} \text{ of } 2\frac{3}{11}}$.

$$(13) \frac{5\frac{1}{2} \text{ of } 4\frac{1}{2} \text{ of } \frac{14}{15} \times \frac{1}{2} + \frac{3}{4} - \frac{1}{8}}{4\frac{2}{3} \text{ of } 3\frac{2}{3} \text{ of } 1\frac{1}{4} \times \frac{1}{2} - (\frac{1}{8} \text{ of } 2\frac{2}{3})}; \frac{1 + \frac{1}{2} + \frac{1}{3}}{2 - \frac{1}{5} \text{ of } \frac{5}{6}}; \frac{8}{20 - \frac{4}{6 - \frac{2}{3} + \frac{4}{5}}} + \frac{7}{3 + \frac{10}{15 - \frac{121}{25} - 1\frac{1}{5}}}$$

$$(14) \frac{5}{7 - \frac{9}{3 - \frac{3}{4}}} + \frac{5}{16 - \frac{11}{2 - \frac{1}{8}}}; \frac{9(3\frac{2}{3} \text{ of } \frac{7}{12})}{5(\frac{6}{4} \text{ of } \frac{2}{5})} + \frac{4}{1\frac{1}{2}} \left(\frac{1\frac{1}{2} \text{ of } 3\frac{1}{3}}{\frac{5}{12} \text{ of } 4\frac{2}{3}} \right).$$

$$(15) \frac{6\frac{2}{3} \text{ of } \frac{2}{15} \text{ of } \frac{5}{18} \text{ of } \frac{6\frac{1}{2} \text{ of } \frac{2}{2\frac{1}{2}} \text{ of } 3\frac{1}{2}}{1\frac{5}{7} \text{ of } \frac{1}{2} + 3\frac{3}{7}}}{2\frac{2}{3} \text{ of } 2\frac{2}{3} \text{ of } \frac{3\frac{1}{2}}{6\frac{1}{8}}}; \frac{6\frac{1}{2} + 3\frac{1}{3} - \frac{1}{4} \text{ of } 4\frac{1}{2} - 2\frac{2}{3}}{5\frac{1}{5} + 7\frac{1}{12} - \frac{1}{80}} \left(\frac{4\frac{1}{2} - 2\frac{2}{3}}{6\frac{1}{2} + 2\frac{2}{3}} \right) + \left(\frac{\frac{5}{7} + \frac{1}{2} \text{ of } \frac{25}{968}}{\frac{6}{7} - \frac{1}{2}} \right).$$

$$(16) \frac{1}{240 + \frac{4320}{108 + \frac{39}{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}}} \times \frac{2268}{1 + \frac{8}{1 + \frac{20}{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}}}. \quad (17) \frac{10}{25 - \frac{7}{\frac{2}{3} + \frac{4}{2\frac{1}{2}}}} + \frac{9}{8\frac{2}{3} - \frac{8}{4 - \frac{1}{2} + \frac{1}{3}}}$$

$$(18) \frac{2 \text{ of } 1\frac{2}{3} \text{ of } 12}{3 + \frac{10}{\frac{1}{2} \text{ of } 10}} + \frac{6\frac{2}{3}}{3 - \frac{6}{3 - (\frac{1}{3} \times \frac{5}{6} \times 3)}}$$

$$(19) \frac{8}{\frac{1}{2} + \frac{5}{12}} + \frac{8}{1\frac{5}{7} + \frac{25\frac{2}{7}}{300 - \frac{107}{\frac{1}{2} + \frac{1}{6} + \frac{1}{7}}}}$$

$$(20) \frac{\frac{1}{2} + \frac{4}{5} + \frac{11}{27} \text{ of } \frac{5}{8} \text{ of } 2\frac{2}{3} + 1\frac{11}{24}}{\frac{1}{4} + \frac{5}{6} + \frac{11}{12}} \div \frac{7}{4 - \frac{6}{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}}; \frac{21}{1\frac{1}{2} + \frac{11\frac{1}{2}}{1 + \frac{11}{12 + \frac{5}{48} + \frac{2}{72}}}}$$

$$\frac{36}{21 - \frac{33}{6 - \frac{7}{2\frac{1}{3} + \frac{2}{3}}}}$$

The following exercise shows the application of multiplication and division to the solution of examples containing concrete quantities.

From the examples worked the pupil will see the best method of obtaining the required result in any particular instance.

Find the value of $\frac{5}{8}$ of £1.

$$\frac{5}{8} \text{ of } \frac{20}{1} = \frac{5}{8} \text{ of } 20 \text{ s.} = 12\frac{1}{2} \text{ s.} = 12 \text{ s. } 6 \text{ d.}$$

Find the value of

\pounds	$s.$	$d.$	\pounds	$s.$	$d.$
3	11	$4\frac{1}{2} \times 3\frac{2}{5}$ or 3	3	11	$4\frac{1}{2} \times \frac{1}{5}$
		4			6
5)	14	5 6	5)	21	8 3
	2	17 $1\frac{1}{8}$			3
	10	14 $1\frac{1}{2}$		64	4 9
	<u>£13</u>	<u>11 $2\frac{7}{10}$</u>		3	11 $4\frac{1}{2}$
			5)	67	16 $1\frac{1}{2}$
				<u>£13</u>	<u>11 $2\frac{7}{10}$</u>

When the numerator of the improper fraction is 12 or less than 12, the second method is the shorter, but otherwise the first.

Divide 2 cwt. 3 qrs. 4 lbs. by $14\frac{2}{5}$.

$$\begin{array}{r}
 2 \text{ cwt. } 3 \text{ qrs. } 4 \text{ lbs.} = 312 \text{ lbs.} \\
 14\frac{2}{5} = \frac{72}{5}
 \end{array}
 \quad
 \begin{array}{r}
 13 \\
 33 \\
 \hline
 312 \times \frac{5}{72} = \frac{95}{8} = 21\frac{5}{8} \text{ lbs.}
 \end{array}$$

The above method may frequently be used with advantage when the denominator of the fraction is large, and likely to cancel.

EXERCISE XXVIII.

- (1) $\frac{7}{18}$ of £1; $\frac{9}{22}$ of £5 10s.; $\frac{3}{4}$ of 13s. 4d.; $\frac{1}{18}$ of £13 13s.; $\frac{1}{8}$ of 17s. 6d.
- (2) $\frac{9}{16}$ of £1 5s.; $\frac{5}{14}$ of £9 16s.; $\frac{1}{12}$ of £4 16s.
- (3) £2 2s. 6d. $\times \frac{2}{5}$; £3 1s. 3d. $\times \frac{5}{11}$; £4 3s. $2\frac{1}{2}$ d. $\times 1\frac{1}{4}$; £15 8s. 11d. $\times 1\frac{3}{11}$.
- (4) £8 8s. $2\frac{3}{4}$ d. $\times 4\frac{3}{8}$; £13 12s. 3d. $\div \frac{9}{10}$; £10 15s. 7d. $\div 1\frac{5}{8}$; £112 10s. 7d. $\times \frac{9}{113}$.
- (5) £19 4s. 11d. $\div 3\frac{1}{8}$; £11 14s. $3\frac{1}{2}$ d. $\times \frac{5}{16}$; £6 12s. 8d. $\times 1\frac{5}{8}$; £3 12s. $2\frac{1}{2}$ d. $\times \frac{6}{77}$.
- (6) £7 14s. $2\frac{1}{2}$ d. $\div 1\frac{7}{9}$; £9 11s. 1d. $\times 4\frac{1}{3}$; £3 6s. 8d. $\times 8\frac{3}{4}$; £7 9s. $2\frac{3}{4}$ d. $\div \frac{9}{11}$.
- (7) £7 0s. 7d. $\times \frac{2}{7}$; £8 4s. $3\frac{1}{4}$ d. $\times \frac{5}{8}$; £14 7s. $3\frac{1}{2}$ d. $\times \frac{1}{7}$; £15 2s. $4\frac{3}{4}$ d. $\times \frac{9}{10}$.
- (8) £3 7s. $10\frac{1}{2}$ d. $\times 3\frac{1}{3}$; £4 5s. $6\frac{1}{2}$ d. $\times \frac{7}{10}$; $\frac{5}{8}$ of 3 tons; $\frac{5}{12}$ of 11 cwt. 2 qrs. 8 lbs.
- (9) 7 cwt. 3 qrs. 2 lbs. 13 oz. $\div 1\frac{3}{8}$; $\frac{5}{8}$ of 2 tons 2 cwt. 2 qrs.; 3 cwt. 7 lbs. $\div 1\frac{1}{4}$; £46 7s. $2\frac{1}{2}$ d. $\div 4\frac{1}{5}$.
- (10) 5 tons 15 cwt. 2 qrs. 6 lbs. 7 oz. $5\frac{1}{2}$ drs. $\div 14\frac{3}{8}$; 11 oz. 7 drs. 2 scr. 5 grs. $\times 1\frac{3}{4}$; $\frac{2}{3}$ of 1 cwt. 1 qr. 4 lbs.; 7s. $9\frac{3}{4}$ d. $\times 5\frac{1}{11}$.

44 EXERCISES IN MULTIPLICATION AND DIVISION OF FRACTIONS.

(11) 45 mls. 5 fur. 3 yds. 2 ft. 9 in. $\times 7\frac{1}{4}$; 3 wks. $5\frac{3}{4}$ dys. $+\frac{7}{32}$; 5 sq. mls. 33A. 1R. $9\frac{5}{8}$ P. $\times \frac{2\frac{2}{3}}{4\frac{2}{3}}$; 2 yrs. 3 wks. 4 dys. $19\frac{1}{2}$ hrs. $+8\frac{1}{4}$.

(12) $17\frac{3}{20}$ of £19 6s. $11\frac{1}{4}$ d.; $\frac{6\frac{5}{8}}{1\frac{1}{4}}$ of £11 11s. $11\frac{1}{2}$ d.; $\frac{2}{3}$ of $6\frac{3}{4}$ s.; 3 tons 6 cwt. $10\frac{3}{4}$ lbs. $+\frac{4\frac{1}{2}}{8}$.

(13) £12 $\frac{1}{2}$ + $5\frac{7}{16}$ s. + $11\frac{3}{4}$ d.; 11 mls. 2 fur. 111 yds. 2 ft. $11\frac{1}{2}$ in. $+\frac{5\frac{3}{8}}{3\frac{1}{2}}$; £7 $\frac{1}{2}$ + $15\frac{3}{8}$ s. + $6\frac{1}{2}$ d.; 92 mls. 4 fur. 103 yds. 2 ft. 11 in. $+\frac{3\frac{5}{8}}{2\frac{1}{2}}$.

(14) £1 $\frac{1}{8}$ + $19\frac{1}{12}$ s. + $(11\frac{3}{4}$ of £ $\frac{3}{16}$); 5 dys. 3 hrs. 17 min. 53 sec. $\times \frac{1\frac{7}{8}}{1\frac{1}{12}}$.

(15) $\frac{2}{3}$ of £16 + $5\frac{5}{8}$ of $6\frac{3}{8}$ s. + $5\frac{1}{3}$ of $1\frac{4}{23}$ d.; $6\frac{7}{8}$ of £3 + $2\frac{1}{2}$ of $1\frac{3}{7}$ of 16s. + $\frac{1}{11}$ of $1\frac{1}{4}$ of 6d.

(16) £55 16s. $8\frac{3}{4}$ d. $+\frac{6\frac{1}{2}}{3\frac{5}{8}} \times 4$; $\frac{5}{16}$ of 4 tons + $\frac{9}{20}$ of 6 cwt. + $1\frac{1}{4}$ of 3 qrs.

To reduce a given quantity to the fraction of another given quantity.

RULE.—Reduce both quantities to the same denomination, and divide the former by the latter.

Reduce 5s. 6d. to the fraction of 11s. $5\frac{1}{2}$ d.

5s. 6d. = 66d. $\times 2$ halfpence and 11s. $5\frac{1}{2}$ d. = 275 halfpence.

$$\frac{66 \times 2}{275} = \frac{132}{275}.$$

Reduce 13 cwt. 3 qrs. 8 lbs. 12 oz. to the fraction of 1 ton 4 cwt.

13 cwt. 3 qrs. 8 lbs. 12 oz. = 24780 oz.

1 ton 4 cwt. = 24 cwt. $\times 4 \times 28 \times 16$.

$$\frac{24780}{24 \times 4 \times 28 \times 16} = \frac{225}{812}.$$

EXERCISE XXIX.

- (1) Reduce 4s. to the fraction of £1; 7s. 6d. to the fraction of 10s.
- (2) Reduce 9s. 4d. to the fraction of £1 1s.; 15s. 2d. to the fraction of 4s. 4d.
- (3) Reduce 7s. 4d. to the fraction of 2s. 9d.; £5 11s. 5d. to the fraction of £17 10s. 2d.
- (4) Reduce £7 15s. 4d. to the fraction of £9 14s. 2d.; 7s. 2½d. to the fraction of 10s. 9¾d.
- (5) Reduce 8s. 8½d. to the fraction of £1 11s. 8d.; £5 5s. 1d. to the fraction of £1 12s. 4d.
- (6) Reduce £3 12s. 8d. to the fraction of £8 12s. 7d.; £5 14s. 7d. to the fraction of £1 17s. 9¾d.
- (7) Reduce £1 6s. 3d. to the fraction of 5¼ guineas; £6 16s. 6d. to the fraction of £3 15s. 10d.
- (8) Reduce £2 0s. 1½d. to the fraction of £1 11s. 1½d.; £1 10s. 4d. to the fraction of £3 17s.
- (9) Reduce 6 lbs. 7 oz. 16 dwts. to the fraction of 9 lbs. 9 oz. 12 dwts.; 1 oz. 10 dwts. 6 grs. to the fraction of 3 oz. 5 dwts. 13 grs.
- (10) Reduce 5 lbs. 4 oz. to the fraction of 1 qr. 7 lbs.; 9 tons 16 cwt. to the fraction of 4 tons 5 cwt. 3 qrs.
- (11) Reduce 9 cwt. 3 qrs. 3 lbs. to the fraction of 1 ton 13 cwt. 27 lbs.; 2 cwt. 1 qr. 18 lbs. to the fraction of 11 cwt. 3 qrs. 20 lbs. 8 oz.
- (12) Reduce 3 cwt. 7 lbs. to the fraction of 1 cwt. 21 lbs.; 2 cwt. 3 qrs. 12 lbs. to the fraction of 16 cwt.
- (13) Reduce 3 cwt. 1 qr. 8 lbs. to the fraction of 1 ton 4 cwt. 3 qrs. 18 lbs.; 1 ton 2 qrs. to the fraction of 2 cwt. 2 qrs. 7 lbs.
- (14) Reduce 15 cwt. 1 qr. 7 lbs. to the fraction of 11 tons 15 cwt. 3 qrs. 7 lbs.; 1 ton to the fraction of 16 cwt. 3 qrs. 14 lbs.
- (15) Reduce 30p. 2 yds. 1 ft. to the fraction of 3 fur. 30p. 4 yds. 2 ft. 1 in.; 3 m. 5 fur. 30p. 3 yds. to the fraction of 14 m. 4 fur. 22p. 5 yds. 1 ft.
- (16) Reduce 3A. 2R. 16P. 15 yds. to the fraction of 1P. 19 yds. 115 in.; 9A. 3R. 20P. to the fraction of 2R. 37P. 15 yds. 6 ft. 108 in.
- (17) Reduce 1 week to the fraction of 6 days 10 hrs.; 3 wks. 2 dys. 13 hrs. 9 min. to the fraction of 15 hrs. 41 min. 55 sec.
- (18) Reduce 7 bus. 2 pks. 2 qts. to the fraction of 2 bus. 1 gal. 3 qts. 1 pt.; 3 qrs. 7 bus. 1 pk. 1 gal. 2 qts. to the fraction of 31 qrs. 3 bus. 2 pks.
- (19) Reduce 3 fur. 6p. 3 yds. 2 ft. to the fraction of 1 mile; 7p. 0 yds. 7 ft. 81 in. to the fraction of 1 acre.
- (20) Reduce 1 qr. 7 bus. 1 gal. to the fraction of 1 quarter; 10 oz. 2 drs. 1 scr. 10 grs. to the fraction of 1 lb.

To reduce the fraction of one given quantity to the fraction of another.

RULE.—Bring them both to one denomination, and divide the one by the other.

Reduce $\pounds \frac{3}{5}$ to the fraction of a guinea.

$$\frac{3}{5} \times \frac{20}{1} \times \frac{1}{21} = \frac{4}{7}.$$

Reduce $1\frac{1}{2}$ of 3 cwt. 0 qr. 18 lbs. to the fraction of 5 cwt. 3 qrs. 5 lbs.

$\frac{9}{11}$	$\frac{4}{12}$	$\frac{4}{23}$
$\frac{11}{9}$	$\frac{12}{28}$	$\frac{28}{28}$
	$\frac{114}{24}$	$\frac{189}{46}$
	$\frac{354}{354}$	$\frac{649}{649}$

$$\frac{11}{3} \times \frac{28}{1} \times \frac{1}{52} = \frac{2}{5}.$$

Reduce $3\frac{3}{7}$ of $\pounds 2$ 3s. 9d. to the fraction of $\pounds 5 \times 20 \times 12$.

$\frac{7}{24}$	$\frac{20}{43}$
$\frac{24}{7}$	$\frac{12}{525}$

$$\frac{24}{7} \times \frac{20}{1} \times \frac{1}{5} \times \frac{1}{20} \times \frac{1}{12} = \frac{2}{5} = 1\frac{2}{5}.$$

EXERCISE XXX.

(1) Reduce $\frac{1}{2}$ of a crown to the fraction of $\pounds 1$; $\frac{7}{15}$ of $\pounds 1$ to the fraction of a guinea.

(2) Reduce $\frac{2}{3}$ of 1s. 6d. to the fraction of $\pounds 1$ 17s. 6d.; $2\frac{1}{2}$ of $\pounds 1$ 13s. 4d. to the fraction of $\pounds 7$.

(3) Reduce $3\frac{4}{5}$ of £1 2s. 6d. to the fraction of £62; $1\frac{3}{8}$ of £1 12s. 6d. to the fraction of £143.

(4) Reduce $1\frac{7}{8}$ of 6s. 8d. to the fraction of 10s.; $2\frac{1}{2}$ of 3 cwt. 2 qrs. to the fraction of a ton.

(5) Reduce $1\frac{1}{2}$ of 3 wks. 6 hrs. to the fraction of 3 mo.; $1\frac{1}{8}$ of £2 14s. 2d. to the fraction of £8 2s. 6d.

(6) Reduce $\frac{9}{15}$ of 2 cwt. 3 qrs. 7 lbs. to the fraction of 3 qrs.; $9\frac{2}{5}$ crowns to the fraction of 25 guineas.

(7) Reduce $2\frac{2}{5}$ of 3 fur. 12p. 4 yds. to the fraction of 1 m. 1 fur. 38p. 1 yd.; $7\frac{1}{2}$ of £2 13s. 2d. to the fraction of £66 9s. 2d.

(8) Reduce $3\frac{1}{3}$ of 8 cwt. 1 qr. 14 lbs. to the fraction of 2 tons 1 cwt. 3 qrs. 14 lbs.; $2\frac{1}{2}$ of 1R. 30P. to the fraction of 2A. 0R. 30P.

(9) Reduce $\frac{8}{15}$ of a furlong to the fraction of 8 fathoms; $7\frac{1}{5}$ of 2 gals. 3 qts. 1 pt. 2 gills to the fraction of a bushel.

(10) Reduce $7\frac{1}{2}$ of 1 yd. 3 qrs. 2 nails to the fraction of 10 ells; $8\frac{3}{4}$ of 4 oz. 3 drs. 1 scr. 10 grs. to the fraction of 1 lb.

(11) Reduce $6\frac{2}{5}$ of 1R. 21P. $24\frac{3}{4}$ yds. to the fraction of an acre; $13\frac{1}{8}$ of 1 wk. 4 dys. 12 hrs. 40 min. to the fraction of a month.

(12) Reduce $1\frac{2}{3}$ of 3R. 24P. 20 yds. to the fraction of 7R. 9P. $9\frac{2}{4}$ yds.; $4\frac{1}{2}$ of a barrel of beer to the fraction of 9 hogsheads of wine.

(13) Reduce $7\frac{1}{3}$ of 1 fur. 28p. 4 yds. to the fraction of 1 mile; $\frac{8}{15}$ of 7 lbs. Troy to the fraction of a lb. Av.

(14) Reduce $3\frac{1}{5}$ of 3 cwt. 1 qr. 12 lbs. 4 oz. to the fraction of 13 cwt. 1 qr. 21 lbs.; $3\frac{1}{8}$ of 5L. 0 m. 1 fur. 25p. to the fraction of a degree.

(15) Reduce $\frac{9}{7}$ of $1\frac{1}{2}$ of £3 14s. 9d. to the fraction of £6 10s. $9\frac{3}{4}$ d.; $\frac{1\frac{1}{2}}{3\frac{3}{4}}$ of $\frac{4\frac{3}{4}}{9}$ of £1 19s. $4\frac{1}{2}$ d. to the fraction of £1 14s. $8\frac{1}{4}$ d.

(16) Reduce $6\frac{1}{8}$ of 1 lb. 7 oz. 15 dwts. 20 grs. Troy to the fraction of 7 lbs. Av.; $\frac{\frac{4}{13} \text{ of } 6\frac{1}{2}}{\frac{5}{17} \text{ of } 3\frac{1}{2}}$ of 16 hrs. 21 min. 40 sec. to the fraction of 1 day.

(17) Reduce $3\frac{1}{13}$ of 1 yd. 3 qrs. 0 nails 2 in. to the fraction of 2 ells; $\frac{2\frac{1}{2} \text{ of } 6\frac{3}{7}}{4\frac{1}{2} \text{ of } 3\frac{1}{4}}$ of 3 pks. 1 gal. 3 qts. 1 pt. to the fraction of 2 bus. 3 pks. 1 qt. 2 gills.

(18) Reduce $9\frac{3}{8}$ of 4 fur. 14p. 3 yds. to the fraction of 15 miles; $\frac{6\frac{7}{8} + 4\frac{3}{8}}{4\frac{5}{8} - 2\frac{7}{16}}$ of 3 cwt. 2 qrs. 21 lbs. to the fraction of a ton.

(19) $\frac{5\frac{9}{11}}{1\frac{10}{11}}$ of 1 ton 4 cwt. 3 qrs. $11\frac{1}{2}$ lbs. to the fraction of 1 ton 13 cwt. 15 lbs.; $\frac{3}{11}$ of $1\frac{2}{3}$ of £4 16s. 8d. to the fraction of $\frac{2}{15}$ of $7\frac{1}{2}$ of £5.

(20) $\frac{\frac{8}{15} \text{ of } 7\frac{7}{9}}{\frac{17}{17} \text{ of } 2\frac{3}{7}}$ of £5 17s. 6d. to the fraction of £3 19s. 2d.; $1\frac{5}{7}$ of $(\frac{3}{8} + \frac{1}{2})$ of £3 6s. 8d. to the fraction of £5.

MISCELLANEOUS EXAMPLES IN FRACTIONS.

EXERCISE XXXI.

(1) What number, added to $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$ will make the total 5?

(2) Divide the sum of $\frac{7}{100}$, $\frac{3}{10}$, $\frac{7}{25}$, $\frac{5}{8}$, $\frac{5}{4}$ by $1\frac{3}{8}$ of $1\frac{400}{1000}$ of $1\frac{7}{8}$.

(3) Reduce $\frac{5}{8}$ of $2\frac{5}{8}$ lbs. Troy to the fraction of 1 lb. Av.; and what fraction of £2 10s. is £ $\frac{5}{8}$?

(4) From $3\frac{1}{2}$ take its fourth, fifth, sixth, twentieth, twenty-fifth, and fiftieth parts; and to the result add the product of the three first parts, and divide the remainder by $7\frac{10}{17}$ of $2\frac{1}{4}$.

(5) If $\frac{1}{3}$ of a ship costs £665 12s. 6d., what is $\frac{5}{8}$ of her worth? and from $\frac{5}{23}$ of £22 $\frac{5}{8}$ take $\frac{7}{13}$ of $\frac{10}{11}$ shillings.

(6) What number added to $7\frac{5}{16}$ will make 10? and what subtracted from $5\frac{1}{2}$ of $2\frac{3}{4}$ will leave $7\frac{3}{14}$?

(7) A merchant who possessed $\frac{1}{3}$ of a ship, sold $\frac{2}{3}$ of his share for £1486 $\frac{1}{2}$; what was the value of the whole?

(8) What part of 1 lb. Av. is 9 oz. 6 $\frac{3}{4}$ dwts.?

(9) Add together $\frac{7}{13}$ of 6 guineas, $\frac{2}{3}$ of 7s. 6d., and $\frac{5}{14}$ of £7 4s. 9 $\frac{3}{4}$ d., and reduce the result to the fraction of £8 10s. 8 $\frac{1}{2}$ d.

(10) If $9\frac{3}{16}$ yds. cost £9 $\frac{3}{16}$, what is the value of $2\frac{11}{12}$ yds.?

(11) What number subtracted from $2\frac{1}{3}$, $6\frac{1}{3}$, $17\frac{11}{12}$, $8\frac{2}{3}$ will leave the sum total $30\frac{5}{8}$? and what number added to $\frac{2\frac{5}{8}}{9-7\frac{2}{15}}$ will make the sum total 15?

(12) Divide $\frac{5}{8}$ by $\frac{7}{12}$, and to the result add their product and difference.

(13) If $\frac{3}{11}$ of a pig cost £7 19s. 4 $\frac{1}{2}$ d., what is the value of $\frac{2}{3}$ of $\frac{2}{3}$ of it?

(14) Find the average of $7\frac{7}{8}$, $\frac{5}{12}$, $\frac{3}{20}$, $4\frac{7}{16}$, $14\frac{3}{5}$, $27\frac{5}{9}$, 0, $3\frac{1}{2}$, $\frac{1}{4}$, 0, $\frac{5}{100}$, $1\frac{1}{2}$.

(15) Name, consecutively, which are the greatest of the following fractions: $\frac{5}{8}$, $\frac{2}{3}$, $\frac{7}{12}$, $\frac{1}{10}$, $\frac{3}{11}$, $\frac{5}{8}$, $\frac{1}{4}$, $\frac{2}{5}$, $\frac{11}{13}$, $\frac{2}{7}$, $\frac{5}{6}$, $\frac{1}{5}$, $\frac{2}{3}$, and $\frac{7}{8}$.

(16) How many yards of carpet, $\frac{2}{3}$ yds. wide, will cover the floor of a room $27\frac{3}{4}$ ft. long, and 10 ft. 8 in. broad? and what will it cost at 3s. 10 $\frac{1}{2}$ d. per yd.

(17) Divide $\frac{10}{21}$ of £3 7s. 6d.; $\frac{3}{11}$ of 2s. 3 $\frac{1}{2}$ d.; $\frac{10}{13}$ of £1 17s. 9 $\frac{3}{4}$ d. by £20 8s. 9 $\frac{5}{8}$ d.

(18) What number taken from $2\frac{1}{2}$ leaves $1\frac{1}{5}$? and what number added to $2\frac{2}{3}$ produces $3\frac{5}{6}$?

(19) What will be the cost of painting a room 19 ft. 8 in. long, 15 ft. 3 in. wide, and $9\frac{1}{2}$ ft. high, at 1s. 6d. the sq. yd.?

(20) If, in an orchard, $\frac{3}{8}$ of the trees are pear, $\frac{1}{16}$ apples, $\frac{1}{12}$ cherry, $\frac{1}{24}$ walnut, and $\frac{2}{3}$ plum, and there are twenty other trees; how many trees does the orchard contain?

(21) Find the continued product of $\frac{7\frac{1}{2}}{5\frac{1}{12}}$, $\frac{3}{1\frac{1}{2}}$, $\frac{7}{5}$, $\frac{5\frac{1}{2}}{10}$, $\frac{17}{3\frac{2}{3}}$, $26\frac{5}{8}$, $\frac{19}{7\frac{1}{12}}$, $\frac{11}{3\frac{1}{2}}$.

(22) Find the value of

$$\frac{140}{54 + \frac{20}{\frac{3}{8}}} - \frac{60}{20 + \frac{100}{\frac{4\frac{1}{2}}{9}}}$$

$$\frac{\frac{1}{8} + \frac{1}{\frac{1}{2} + \frac{1}{4} - \frac{11}{60}}}{5\frac{1}{2} + \frac{3}{\frac{2}{3} + \frac{4}{5} + \frac{7}{27}}}$$

(23) Express as a fraction of £71 5s. the difference of $\frac{5}{7}$ of 2 guineas, and $\frac{2\frac{1}{2}}{1\frac{4}{12}}$ of 3 of £1 2s. 6d.

(24) What number added to $\frac{3}{8}$, $\frac{3}{2}$, $\frac{5}{9}$, $\frac{7}{12}$, $\frac{11}{18}$, $\frac{5}{24}$ will make the sum total 4?

(25) A gentleman's estate consists of $\frac{2}{3}$ arable, $\frac{1}{4}$ pasture, and 130 acres woodland; the whole averages 24s. 6d. per acre: what is his income?

(26) Divide $5\frac{1}{2}$ of $\frac{5}{22}$ of 3 of $7\frac{3}{4}$ of $8\frac{5}{31}$ of $\frac{6}{11}$ by the difference of $5\frac{7}{8}$ and $5\frac{7}{24}$, and to the result add $\frac{7\frac{5}{8}}{2\frac{3}{4} + \frac{7}{18} + 3\frac{5}{8}}$ of $\frac{1\frac{5}{28}}{1\frac{32}{4}}$ of $\frac{2\frac{28}{33}}{1\frac{58}{81}}$.

(27) A can do a piece of work in 11 days, and B can do it in 9 days; in what time can they do it together?

(28) Add together $\frac{5}{8}$ of £5 3s. 4d., $\frac{12}{10}$ of £1 16s. 5d., and $\frac{8}{9}$ of £11 0s. 3 $\frac{3}{4}$ d., and reduce the result to the fraction of £37 15s. 9 $\frac{1}{3}$ d.

(29) Find the value of

$$\frac{2}{1 + \frac{118}{113}} - \frac{264 - \frac{\frac{5}{12} + \frac{3}{11} + \frac{1}{8}}{\frac{22}{25}}}{2\frac{1}{8} - \frac{\frac{3}{25}}{\frac{287}{300}} - 2 - \frac{\frac{3}{8} + \frac{9}{10} + \frac{11}{60}}{\frac{22}{25}}} \times \frac{6\frac{83}{132}}{1 + \frac{\frac{86}{121}}{1\frac{1}{11} + \frac{2\frac{1}{11}}{\frac{1}{2} + \frac{2}{3} + \frac{3}{4}}}}$$

(30) A, B, and C can do a piece of work in 4 days, A and C in 6 days, B and C in $5\frac{1}{3}$ days; in what time can C do it alone?

(31) If from 1 lb. Troy $46\frac{28}{45}$ sovereigns are coined, how many can be coined out of 1 ton of gold?

(32) Find the value of $\frac{11\frac{3}{4} + 2\frac{2}{3}}{5\frac{1}{7}}$ of $\frac{1\frac{3}{2}}{3\frac{2}{13} + 2\frac{4}{15}} + \frac{1\frac{3}{2}}{1\frac{4}{18} \times 1\frac{1}{12}}$.

(33) Required the value of a balk of timber which measures 21 ft. 4 in. long, 1 ft. 8 in. broad, and 9 in. deep, at 2s. 9d. per cubic foot.

(34) In the above example, how much must be cut off the plank to contain 5 cubic feet?

(35) Reduce $\frac{3\frac{3}{4} \text{ of } 5\frac{1}{2}}{2\frac{1}{2}} - \frac{9\frac{6}{10} \text{ of } \frac{5}{81}}{\frac{2}{18} + \frac{2}{3}}$ of £50 12s. 6d. to the fraction of $1\frac{7}{35}$ of £4 19s.

(36) A person after spending $\frac{2}{5}$ of $\frac{3}{10} + \frac{5}{7}$ of $2\frac{1}{2}$ of his income in smoking, $\frac{2}{5}$ of $\frac{2}{5} + 4\frac{1}{2}$ of $\frac{3}{10}$ in clothes, and $\frac{1}{12}$ in incidental expenses, has £420 left; required his income.

(37) A and B can do a piece of work in 6 days, A and C in 8 days, and B and C in 12 days; in what time can they do it separately and together?

(38) Find the value of

$$\frac{\frac{\frac{75}{121}}{1 + \frac{5}{11}} - \frac{1}{1 + \frac{8}{21}}}{\frac{\frac{5}{12} + \frac{1\frac{2}{3}}{6\frac{2}{3}}}{8 - \frac{2}{7} + \frac{11}{14}}}$$

(39) A vessel's cargo worth £10,000 gets damaged, and the owner consequently sells $\frac{1\frac{3}{11}}{1\frac{4}{21}}$ of $\frac{3\frac{1}{7}}{5\frac{1}{5}}$ of it for half the former value of the whole cargo; what is the value of the remainder at the same rate, and what will he lose on the whole cargo by selling at this rate?

(40) If $\frac{5\frac{5}{8} \text{ of } 6\frac{2}{7} \times 5\frac{5}{8} \text{ of } 2\frac{7}{9}}{6\frac{2}{7} \text{ of } 3\frac{2}{3} \times 9\frac{3}{8} \text{ of } 2\frac{11}{12}}$ of the population of a town is 15,824, what is the whole population?

(41) A can do a piece of work in a day of 10 hrs., B can do it in $\frac{2}{3}$ of a day, and C in $\frac{9}{10}$ of a day. A works by himself 2 hrs.; he is then joined by B, and they work together 3 hrs. more; C then joins them: how long will it take the three to complete the work?

(42) If $\frac{2}{21}$ of $(5\frac{3}{4} - 1\frac{1}{12})$ of an estate cost 600 guineas, what will $7\frac{5}{8} - 6\frac{7}{12} + 8\frac{3}{8}$ of $\frac{3}{18}$ of it cost?

(43) If $\frac{2}{10}$ of $\frac{1\frac{5}{11}}{1\frac{1}{3}}$ of $\frac{2}{7}$ of $\frac{8\frac{5}{8}}{3\frac{3}{8}}$ of a mine be worth £1976 13s. 4d., what is the value of $\frac{7}{12}$ of $\frac{2}{3}$ of $2\frac{1}{7}$ of $\frac{1}{5}$ of it?

(44) Find the value of

$$\frac{59}{273} + \frac{\frac{4\frac{11}{13}}{1 - \frac{1}{6}}}{7 - \frac{2}{7 + \frac{7}{13}}}$$

(45) A person has three creditors to whom he owes 20, 30, and 50

guineas, and pays them respectively $\frac{3}{5}$, $\frac{3}{7}$, and $\frac{19}{35}$ of their debts; reduce what he still owes to the fraction of what he has paid.

(46) Find the value of

$$\frac{4\frac{2}{3} - 1\frac{5}{7}}{3\frac{5}{8} + \frac{7}{24}} \text{ of } \frac{3\frac{5}{12} - 1\frac{2}{11}}{11\frac{1}{2} - 6\frac{8}{15} + 3\frac{1}{10}} \text{ of } \frac{6\frac{2}{3} \text{ of } \frac{3\frac{1}{2}}{3\frac{1}{2}}}{1\frac{2}{29} \text{ of } 2\frac{2}{3} \text{ of } 5\frac{9}{10} \text{ of } \frac{5}{14} \text{ of } 1\frac{3}{47}}.$$

(47) A gentleman spent $\frac{1}{3}$, $\frac{1}{5}$, and $\frac{1}{8}$ of his property in 20 years, and found that he had then £4860 left; what was the value of his property and his average yearly expenditure?

(48) The imperial gallon contains $277\frac{1}{4}$ cubic inches nearly; how many quarters, &c. will a corn-bin contain which measures 4 feet by 3 feet by $2\frac{3}{4}$ feet?

(49) A cistern can be filled by 2 pipes, *A* and *B*, in 30 and 40 min. respectively, and emptied by another pipe, *C*, in 20 min. If all these are left open, how long will it take to fill the cistern?

(50) Find the value of $\frac{27\frac{5}{6} \text{ of } 28\frac{1}{4} + 3\frac{9}{7} \text{ of } 1\frac{1}{3}}{20\frac{2}{3} \text{ of } 75\frac{1}{2} + 7\frac{5}{7} \text{ of } 2\frac{2}{3}}$ of £1 13s. 4d. + $2\frac{1}{2}$ of 6s. 8d. + $4\frac{4}{11}$ of 2s. $3\frac{1}{2}$ d., and divide the sum by $26\frac{2}{3}$ of 4s. $4\frac{1}{2}$ d.

(51) If £10 15s. 3d. be expended in purchasing a carpet $\frac{2}{3}$ of a yard wide, at 4s. 6d. per yard, for a room 19 ft. long and 17 ft. broad, how much of the floor will remain uncovered of the same breadth all round?

(52) Subtract from and add to 4 the following fractions: $\frac{7}{5}$, $\frac{5}{8}$, $\frac{3}{4}$, and $\frac{2}{3}$, and divide the difference of the two products by 20.

(53) How many planks 17 ft. $5\frac{1}{4}$ in. long and $7\frac{1}{2}$ in. wide will be required to floor a room $37\frac{1}{2}$ yds. long and 13 yds. broad, and what will be the cost at $6\frac{1}{2}$ d. per sq. yd.?

(54) Find the value of

$$\frac{\frac{121}{123}}{4\frac{1}{2} - \frac{10}{2}} - \frac{30}{130 - \frac{25}{2}}.$$

$$\frac{45 - \frac{1}{4} - \frac{1}{2}}{\frac{1}{4} - \frac{1}{2}} \quad 10 - \frac{\frac{9}{10} - \frac{2}{3}}{\frac{9}{10} - \frac{2}{3}}$$

(55) What fraction of half a hundredweight is $2\frac{23}{25}$ of 3 lbs. 6 oz. 5 dwts. 6 grs., and what must be given for 11 oz. of gold if $\frac{1}{4}$ cwt. be worth £1333 6s. 8d.?

(56) A person after having withdrawn from a company $2\frac{1}{2} + 7\frac{8}{15} - \frac{2}{15} + \frac{11}{12}$ of $\frac{2}{3}$ of 14 of his funds, finds that $\frac{1}{3}$ of his remaining money represents £34 7s. 6d.; how much had he invested at first?

(57) *A*, *B*, and *C* can do a piece of work in 2 days, *A* and *C* in $6\left(\frac{7\frac{2}{3} \text{ of } 12\frac{2}{3}}{2\frac{9}{5} \text{ of } 15\frac{5}{6}}\right) - 3\left(\frac{2\frac{1}{7} \text{ of } 4\frac{1}{3}}{2\frac{11}{12} \text{ of } 2\frac{1}{2}}\right)$ days, *B* and *C* in $4\frac{1}{2}$ days; in what time can *B* do it alone?

(58) If $\frac{6\frac{3}{5} \text{ of } 6\frac{1}{2} - 3\frac{4}{7} \text{ of } 2\frac{1}{3}}{3\frac{4}{5} \text{ of } 17 - 12\frac{1}{2} \text{ of } 1\frac{1}{2}}$ of a flock of sheep cost £1272 19s., what would the whole cost?

DECIMALS.

A Decimal is a fraction whose denominator is ten or some power of ten (as 10, 100, 1000, 10,000, &c.), according as there are 1, 2, 3, 4 or more figures in the numerator, $\frac{5}{10}$, $\frac{25}{100}$, $\frac{325}{1000}$ are decimal fractions, and are generally expressed by a (.) before the figure, instead of writing the denominator as .5, .25, .325, .4325. From this it will be seen that decimals may be converted into vulgar fractions by placing for the denominators as many ciphers as there are figures in the decimal, with 1 prefixed, and then reducing to their lowest terms (e.g.), $.5 = \frac{5}{10} = \frac{1}{2}$, $.25 = \frac{25}{100} = \frac{1}{4}$, $\frac{235}{1000} = \frac{47}{200}$, and so on. Ciphers added to the right of a decimal do not alter its value, for $.50 = \frac{50}{100} = \frac{1}{2}$, which is the same value as .5, but by prefixing ciphers you decrease the decimal tenfold (e.g.) $.05 = \frac{5}{100} = \frac{1}{20}$.

To reduce a decimal to a vulgar fraction, annex ciphers to the numerator and divide by the denominator (e.g.)

$$\frac{.47}{.25} = \frac{2,00 \overline{)47.00}}{235}.$$

The reason of this rule is obvious, for as $\frac{47}{200}$ was obtained by reducing $\frac{235}{1000}$ to its lowest terms, which did not alter the value of the fraction, consequently $47 \div 200$ must give the same decimal as $235 \div 1000$; if a whole number be prefixed to the decimal the whole number will remain unaltered after reducing the decimal to a vulgar fraction.

EXERCISE XXXII.

Express as decimals

(1) $\frac{3}{10}$; $\frac{14}{10}$; $\frac{77}{100}$; $\frac{119}{1000}$.

(2) $\frac{1027}{1000}$; $\frac{1}{1000}$; $\frac{36}{10000}$; $\frac{719}{100000}$.

(3) $\frac{1287}{10000}$; $\frac{9}{100000}$; $\frac{17}{1000000}$; $\frac{51792}{10000000}$.

EXERCISE XXXIII.

Express as vulgar fractions

- (1) $\cdot 9$; $\cdot 19$; $\cdot 025$; $\cdot 85$.
 (2) $\cdot 0035$; $1\cdot 027$; $11\cdot 5725$; $2\cdot 076125$.
 (3) $7\cdot 390625$; $9\cdot 1953125$; $15\cdot 000025$; $7\cdot 000125$.

EXERCISE XXXIV.

Reduce to decimals

- (1) $\frac{5}{8}$, $\frac{9}{16}$, $\frac{9}{128}$, $\frac{54}{128}$, $\frac{3}{40}$, $\frac{13}{128}$.
 (2) $\frac{7}{8}$, $\frac{13}{80}$, $\frac{11}{3200}$, $\frac{97}{3125}$.
 (3) $\frac{519}{512}$, $\frac{1212}{8400}$, $\frac{715}{80}$, $\frac{1}{1024}$.
 (4) $14\frac{1131}{78128}$, $7\frac{303}{4096}$.
 (5) $\frac{343803}{31250}$, $\frac{625}{30480}$.
 (6) $16\frac{1}{9} + \frac{23}{32}$, $\frac{2}{7}$ of $\frac{7}{1800}$.
 (7) $5\frac{1}{2}$ of $4\frac{1}{2}$ of $\frac{81}{121}$ of $\frac{11}{84}$.

Decimals are said to be **Repeating**, **Recurring**, **Circulating**, or **Interminate**, when the same figure or set of figures recur constantly, as $\cdot 333$, &c. $= \cdot \dot{3}$; this is called a pure repeater, as the same figure always recurs, and is marked with a (\cdot) over the figure as well as a decimal point before it. $\cdot 28571\dot{4}$; this is generally called a circulating decimal, as the same set of figures constantly recur as it were in a circle. We have also mixed repeaters and mixed circulating decimals where part of the decimal repeats and part does not, as $\cdot 1\dot{6}$ and $\cdot 6\dot{5}31$.

EXERCISE XXXV.

Reduce to decimals

- (1) $\frac{11}{8}$; $1\frac{7}{8}$; $\frac{73}{32}$; $2\frac{1}{16}$.
 (2) $\frac{1}{111}$; $\frac{121}{33}$; $\frac{514}{1685}$; $\frac{51}{83}$.
 (3) $\frac{112}{111}$; $\frac{9100}{7000}$; $\frac{120}{85}$; $\frac{72}{85}$.
 (4) $3\frac{1}{21}$; $\frac{67}{33}$; $\frac{1}{21}$; $\frac{1}{43}$.
 (5) $\frac{1}{48}$; $\frac{1}{53}$; $\frac{2}{7}$; $\frac{1}{121}$.

To reduce repeating or circulating decimals to fractions.

RULE.—Place as many nines for the denominator as you have repeating or circulating decimals. The reason of this rule is explained in works on algebra under the head of geometric progressions.

$$\cdot 3 = \frac{3}{9} = \frac{1}{3}. \quad \cdot 428571 = \frac{428571}{999999} = \frac{1}{3}.$$

To reduce mixed, repeating, or circulating decimals to fractions.

RULE.—From the whole subtract the non-repeating part, and for the denominator place as many nines as there are repeating or circulating figures, with ciphers for the non-repeating figures.

$$\cdot 16 = \frac{16 - 1}{90} = \frac{15}{90} = \frac{1}{6}. \quad \cdot 65296 = \frac{65296 - 65}{99900} = \frac{65231}{99900} = \frac{1763}{2700}.$$

EXERCISE XXXVI.

Reduce to vulgar fractions

- (1) $\cdot 6$; $\cdot 27$; $\cdot 36$; $\cdot 296$.
- (2) $2\cdot 126$; $3\cdot 212$; $\cdot 037$; $\cdot 2567$.
- (3) $\cdot 4684$; $\cdot 571428$; $2\cdot 765142$; $1\cdot 50675$.
- (4) $\cdot 843834$; $\cdot 253127$; $4\cdot 6874$; $2\cdot 428571$.
- (5) $2\cdot 174803$; $3\cdot 2142857$; $6\cdot 3571428$; $\cdot 1076923$.

ADDITION AND SUBTRACTION OF DECIMALS.

RULE.—Keep the decimal points in a line, place the whole number, if any, to the right of the points, and suppose the blanks to be filled up with ciphers. Add or subtract as in common integers.

3·246834	
1·0004	
·356783	
2·5	6·47
7·642	3·832645
<u>14·746017</u>	<u>2·637355</u>

EXERCISE XXXVII.

Find the value of

- (1) $7\cdot 097 + 8\cdot 365 + 9\cdot 0724 + \cdot 00615 + 11\cdot 25$.
- (2) $109\cdot 6712 + \cdot 00056 + 71\cdot 254 + \cdot 01 + \cdot 78623 + 10\cdot 98701$.
- (3) $\cdot 07692 + 11\cdot 9872 + 8\cdot 175 + 6\cdot 54 + \cdot 08167$.
- (4) $\cdot 4965 + 142\cdot 765002 + \cdot 005 + 1\cdot 97 + 18\cdot 675145$.
- (5) $21\cdot 900001 + 3\cdot 0065 + 1\cdot 75 + \cdot 001275 + \cdot 965$.
- (6) $1\cdot 9675 - \cdot 00212$; and $42\cdot 9621 - 41\cdot 997968$.

- (7) $6.596 - 4.00989$; and $11.54 - .095$.
 (8) $9.12765 - 8.9$; and $.0087 - .00095$.
 (9) $.0006 - .00000967$; and $.005 - .0049$.
 (10) $.0157 - .002367$; and $1.2306 - .0197$.

Addition and subtraction of repeating decimals may be performed by carrying out the repeaters sufficiently far to point the true repeating figures on adding or subtracting.

$$6.729 + 2.18 + .36 + 123.25 + .6 + .01.$$

6.729	729729729729
2.181	818181818181
.363	636363636363
123.25	
.666	666666666666
.01	
133.201	850941850941

$$97.6856 - 52.765436.$$

97.685656	5656565656
52.765436	4364364364
44.920220	1292201292

EXERCISE XXXVIII

Find the value of

- (1) $1.125 + 7.43862 + .126573 + 9.567 + 2.8765$.
 (2) $7.261 + .729 + 5.25 + 11.647859 + 1.72 + .6$.
 (3) $7.63 + .985432 + .3 + 8.2546 + 9.729 + .6 + .1543145 + 2.964$
 $+ 718542 + 64$.
 (4) $1.297 - .6854$; and $.789265 - .3$.
 (5) $.54 - .239657$; and $.25 - .248$.
 (6) $34.397241 - 21.42$; and $217.11 - 107.285714$.

MULTIPLICATION OF DECIMALS.

RULE.—Multiply as in common integers, and point off in the product as many decimal places as there are in the multiplier and multiplicand. If more decimal places are required, put in ciphers to the left. Ciphers to the right

are merely used in counting the number of places, and are not used in the answer.

3.006	·00005067	·00004
·00307	3.004	6.05
<u>21042</u>	<u>20268</u>	<u>·0002420</u>
9018	1520100	
<u>·00922842</u>	<u>·00015221268</u>	

EXERCISE XXXIX.

Find the value of

- (1) 1.74×1.2 ; and 9.72×1.12 .
- (2) $9.673 \times .021$; and 79.81×6.19 .
- (3) $.0092 \times .167$; and 9872.06×514 .
- (4) $86.54 \times .00017$; and $.07852 \times 1.99$.
- (5) $.001976 \times 1400$; and $.003 \times 17 \times .027 \times 5000$.
- (6) $18.72 \times .0114 \times .00003 \times 70000$; and $.016 \times .011 \times 720 \times .005 \times 9000$.

DIVISION OF DECIMALS.

RULE.—Divide as in common integers, and point off in the quotient as many decimal places as those in the dividend exceed those in the divisor. If there should be more decimal places in the divisor than in the dividend, add on as many ciphers to the quotient as the number of decimal places in the divisor exceeds those in the dividend, and the answer will be all whole numbers.

$$\begin{array}{r}
 47.269 \overline{) 347.8100289} \quad (7.3581 \\
 \underline{330883} \\
 169270 \\
 \underline{141807} \\
 274632 \\
 \underline{236345} \\
 382878 \\
 \underline{378152} \\
 47269 \\
 \underline{47269} \\
 \hline
 \hline
 \end{array}$$

$$\cdot 00000027) 22\cdot 68 \text{ (84000000)}$$

$$\begin{array}{r} 216 \\ \hline 108 \\ 108 \\ \hline \end{array}$$

$$2\cdot 01) \cdot 00000869727 \text{ (}\cdot 000004327\text{)}$$

$$\begin{array}{r} 804 \\ \hline 657 \\ 603 \\ \hline 542 \\ 402 \\ \hline 1407 \\ 1407 \\ \hline \end{array}$$

EXERCISE XL

Find the value of

- (1) $9\cdot 375 \div \cdot 75$; and $390\cdot 625 \div \cdot 0625$.
- (2) $854\cdot 2296 \div \cdot 00192$; and $921\cdot 6 \div \cdot 0048$.
- (3) $59\cdot 049 \div \cdot 405$; and $262\cdot 144 \div \cdot 000128$.
- (4) $11764\cdot 9 \div \cdot 00245$; and $\cdot 004 \div 10$.
- (5) $16 \div \cdot 0004$; and $9\cdot 216 \div \cdot 0256$.
- (6) $83\cdot 521 \div 144\cdot 5$; and $3\cdot 825809 \div \cdot 00338$.
- (7) $7\cdot 5 \div 62\cdot 5$; and $8\cdot 042292 \div \cdot 0012$.
- (8) $12\cdot 65 \div \cdot 000000125$; and $\cdot 28398241 \div 73$.
- (9) $2839\cdot 8241 \div \cdot 00073$; and $\cdot 952576 \div 976$.
- (10) $26\cdot 896 \div \cdot 000000164$; and $\cdot 229441 \div 479$.
- (11) $940 \div \cdot 00175$.

Multiplication and division of repeaters may be performed in the usual way when only one quantity repeats. If both repeat they must be turned into vulgar fractions.

$$1\cdot 387\dot{4} \times 112\cdot 5$$

$$\begin{array}{r} 1\cdot 387\dot{4} \overline{) 112\cdot 5} \\ \underline{112\cdot 5} \\ 6892\dot{4} 24 \\ \underline{275797} 97 \\ 1387\dot{4} 74 74 \\ \underline{1387\dot{4} 747} 47 \\ 156\cdot 069\dot{4} 42 \\ \hline \end{array}$$

Find the value of $\cdot 68125$ of £1.

$$\begin{array}{r}
 \cdot 68125 \\
 \underline{20} \\
 13 \cdot 62500 \\
 \underline{12} \\
 7 \cdot 500 \\
 \underline{4} \\
 20
 \end{array}
 \quad \text{Ans. } 13s. 7\frac{1}{2}d.$$

Find the value of $\cdot 75$ of 1 ml. 6 fur. 34p. 2 yds. 2 ft. 6 in. In this instance the quantity must be reduced to inches before you proceed to multiply.

ml. fur. p. yds. ft. in.	inches.
1 6 34 2 2 6	117714
8	$\cdot 75$
<u>14</u>	<u>588570</u>
40	823998
594	12) 88285·50
<u>5$\frac{1}{2}$</u>	3) 7357—1·5 inches
2972	2452—1 ft.
297	<u>2</u>
<u>3269</u>	11) 4904 yds. yds. ft. in.
8	4,0) 44,5— $\frac{2}{3}$ =4 1 6
<u>9809</u>	8) 11—5 pls. 1 1·5
12	<u>1 3 5</u> <u>4 2 7·5</u>
117714 inches.	

Ans. 1 ml. 3 fur. 5p. 4 yds. 2 ft. 7·5 in.

EXERCISE XLII.

Find the value of

- | | |
|------------------------------------|-----------------------------------|
| (1) $\cdot 35$ of £1. | (2) $\cdot 125$ of £1. |
| (3) $2\cdot 45$ of £1. | (4) $12\cdot 75$ of £10. |
| (5) $3\cdot 275$ of 3s. 4d. | (6) $1\cdot 2825$ of 16s. 8d. |
| (7) $5\cdot 8125$ of £5. | (8) $\cdot 085625$ of £10. |
| (9) $2\cdot 125$ of 6 gs. | (10) $4\cdot 88125$ of £4 6s. 8d. |
| (11) $\cdot 8125$ of 2 tons 4 cwt. | (12) $\cdot 375$ of 1 qr. 14 lbs. |
| (13) $\cdot 1725$ of 1 m. 6 fur. | (14) $3\cdot 275$ of 1 yd. 2 ft. |
| (15) $\cdot 48225$ of 4A. 2R. | (16) $4\cdot 125$ of 24 sq. yds. |
| (17) $\cdot 028125$ of 5 bushels. | (18) $9\cdot 375$ of 12 days. |
| (19) $8\cdot 0375$ of £20 3s. 4d. | (20) $26\cdot 3125$ of £1 6s. 4d. |

- (21) 17·375 of £2 0s. 4d. (22) 12·625 of £2 17s. 0d. ,
 (23) 7·175 of 5s. 4d. (24) 8·375 of 8 gs.
 (25) £75 + ·125s. + ·15 of a crown.
 (26) £75625 + ·375 of 2s. 6d. + ·75 of £1 10s.
 (27) 10·125 of 8d. + ·4325 of 16s. 8d. + ·75 of a guinea.
 (28) ·7625 of £4 + 3·75 of 7 gs. — 8·25 of 35s.
 (29) ·125 of 3 mls. 6 fur. 24p. 4 yds. 2 ft. 4 in.
 (30) ·375 of 2A. 2R. 20P. 4 yds. 3 ft. 8 in.
 (31) 3·45 of 2 qrs. 4 lbs. 8 oz. 2 drs.
 (32) 1·75 of 4 oz. 8 dwts. 6 grs.
 (33) 5·92 of 3 oz. 6 drs. 1 scr. 5 grs.
 (34) 4·62 of 1 wk. 3 dys. 8 hrs. 14 min. 10 sec.
 (35) 1·56 of £4 4s. 2d. (36) ·526 of 2 m. 4 fur. 20p.
 (37) 1·36 of 3A. 3R. 25P. (38) 2·75 of 2 cwt. 2 qrs. 25 lbs.
 (39) 1·83 of 6s. (40) 1·67 of £81.
 (41) 1·5 of 6s. 1½d. (42) 1·76 of 6s. 3d.
 (43) 1·243 of 3s. 1d. (44) 1·619047 of 2s. 7½d.
 (45) 2·625 of 2 qrs. 4 lbs. (46) 14·672 of 6s. 10½d.
 (47) 14·69 of 8½d. (48) 1·0625 of £72.
 (49) 1·125 of £68. (50) 2·76327 of £25.
 (51) 7·7954 of 11s. (52) ·83428571 of £8 16s.
 (53) ·45528 of £10 5s. (54) 1·44583 of £12.
 (55) 3·714285 of £13. (56) 1·7307692 of £5 4s.
 (57) 12·923076 of 16s. 3d. (58) 14·03 of 1 gal. 3 qts. 1 pt.
 (59) ·3656986531 of 1 league 2 miles 5 furlongs.
 (60) ·0836538461 of 5 lbs. 5 oz. apothecaries.
 (61) ·285714 of 4A. 2R. (62) ·238095 of 2216 tons 5 cwt.
 (63) ·15416 of 2 yrs. 4 wks. (64) ·11851 of 3 yds. 3 qrs.
 (65) ·057954 of 69 m. 3 fur. (66) ·428571 of 1 ton 2 cwt.
 (67) ·0482142857 of 4 tons 10 cwt. (68) 1·00714285 of 3 fur. 20P.
 (69) ·50024058361391694725028 of 18A. 3R.
 (70) ·62867647058823529411 of 1A. 2R. 32P.

To reduce a given quantity to the decimal of another given quantity.

RULE.—If the quantity is to be reduced to a quantity containing two or more denominations, both quantities must be reduced to the lowest denomination mentioned in either. After reducing the fraction to its lowest term, reduce it to a decimal.

Reduce £2 17s. 3d. to the decimal of £5 0s. 2½d.

$$£2 \ 17s. \ 3d. = 687 \times 4 \text{ farthings.}$$

$$£5 \ 0s. \ 2\frac{1}{2}d. = 4809 \text{ farthings.}$$

$$\frac{687 \times 4}{4809} = \frac{2748}{4809} = \frac{916}{1603} = .571428.$$

If the quantity is to be reduced to a quantity containing only one denomination. Commence with the lowest denomination given, and proceed step by step to the denomination required, prefixing each whole number before its own particular denomination.

Reduce £2 4s. 5½d. to the decimal of £4.

$$\begin{array}{r} 12) \ 5 \cdot 2500 \\ 2,0) \ 4 \cdot 43750,0 \\ 4) \ 2 \cdot 22187500 \\ \hline .55546875. \end{array}$$

Reduce 2 cwt. 3 qrs. 8 lbs. to the decimal of a ton.

$$\begin{array}{r} 8 \text{ lbs.} = \frac{8}{28} = \frac{2}{7}. \\ 7) \ 2 \cdot 000000 \\ 4) \ 3 \cdot 285714285714 \\ 2,0) \ 2 \cdot 82142857142,8 \\ \hline .141071428571. \end{array}$$

EXERCISE XLIII.

Reduce

- (1) 7s. 6d. to the decimal of £1; 10s. 6d. to the decimal of 15s.
- (2) 12s. 9d. to the decimal of £1 5s.; 2s. 3¾d. to the decimal of 5s.
- (3) 7s. 10½d. to the decimal of 15s. 9d.; 15s. 1½d. to the decimal of £5.
- (4) 3s. 8½d. to the decimal of £1; 7s. 9¾ to the decimal of £2 10s.
- (5) 2s. 2½d. to the decimal of 3s. 6d.; £1 7s. 6d. to the decimal of £1 2s.
- (6) £2 9s. 7½d. to the decimal of £5; £3 3s. 3¾d. to the decimal of £5 12s. 6d.
- (7) 5 bus. 3 pks. 1½ gals. to the decimal of 2 pks.; 5 cubic yds. 5 ft. 1296 in. to the decimal of 4 cubic yds.
- (8) 12 dwts. 16½ grs. Troy to the decimal of 8 oz. Avoirdupois; 7 oz. 2 dwts. 18½ grs. Troy to the decimal of 2 lbs. 4 oz. Av.
- (9) £2 17s. 6d. to the decimal of £5; £2 5s. 6½d. to the decimal of £1 7s.

Reduce

(10) £9 4s. 6½d. to the decimal of £2 10s.; £3 15s. 6½d. to the decimal of £2 10s.

(11) £7 13s. 5½d. to the decimal of £25; £3 7s. 9½d. to the decimal of £1 4s.

(12) 8 cwt. 2 qrs. 12 lbs. 9 oz. 4 drs. to the decimal of 1 ton 12 cwt.; 6 lbs. 14 oz. 8 drs. to the decimal of 2 lbs. 8 oz.

(13) £1 9s. 3d. to the decimal of £3 0s. 8d.; 13 oz. 9 drs. Av. to the decimal of 1 lb.

(14) 5 oz. 11 drs. to the decimal of 2 qrs.; £10 5s. 9d. to the decimal of £1 2s. 6d.

(15) £2 7s. 6¾d. to the decimal of 16s.; 4 cwt. 3 qrs. 0 lbs. 15 oz. 12 drs. to the decimal of a ton.

(16) 6¾ in. to the decimal of 3½ yds.; 2 nls. 1½ in. to the decimal of ½ in.

(17) 8½ dys. to the decimal of ½ yrs.; 24 sq. yds. 2 ft. 36 in. to the decimal of 25 sq. yds.

(18) 2¼ sec. to the decimal of 1 wk.; £5 19s. 6¾d. to the decimal of £13.

(19) £17 8s. 5½d. to the decimal of £16; 7s. 3¾d. to the decimal of 1 guinea.

(20) 10 oz. 4 drs. Av. to the decimal of 1 lb.; 12 lbs. 15 oz. 8 drs. to the decimal of 1 qr.

(21) £17 14s. 8¾d. to the decimal of £30; £2 15s. 6⅞d. to the decimal of £3 10s.

(22) £6 19s. 11¾d. to the decimal of £8; £4 4s. 5¾d. to the decimal of £5.

(23) £3 0s. 6¾d. to the decimal of £8 1s. 5d.; £17 15s. 9¾d. to the decimal of £10.

(24) £10 6s. 7¾d. to the decimal of £6; £2 17s. 2½d. to the decimal of £2 10s.

(25) 2 qrs. 2 lbs. 13 oz. 4 drs. to the decimal of 3 qrs.

(26) 15 cwt. 3 qrs. 20 lbs. 12 oz. 8 drs. to the decimal of 21 tons.

(27) 1 cwt. 1 qr. 5 lbs. 5 oz. 6¾ drs. to the decimal of 4 tons 16 cwt.

(28) 1 ml. 3 fur. 30p. 2 yds. 1 ft. 6 in. to the decimal of a league.

(29) 1 wk. 4 dys. 14 hrs. 2 min. 30 secs. to the decimal of 4 wks.

(30) 7 tons 15 cwt. 27 lbs. 15 oz. 15¾ drs. to the decimal of 8 tons.

(31) 1A. 2R. 13P. 12 yds. 7 ft. 72 in. to the decimal of 2 acres.

(32) 4 mos. 2 wks. 5 dys. 16 hrs. 20 min. to the decimal of 6 months.

(33) 2 fur. 35p. 4 yds. 2 ft. 3 in. to the decimal of a mile.

(34) 2 mls. 5 fur. 37p. 3 yds. 2 ft. 7½ in. to the decimal of 7 leagues.

(35) 2A. 3R. 25P. 26 yds. 8 ft. to the decimal of 3 acres.

MISCELLANEOUS EXAMPLES IN DECIMALS.

EXERCISE XLIV.

- (1) Reduce 15s. 3d. to the decimal of £2; find the value of £95 + 1·25 of a crown + ·125 of 6d. — ·45 of 11s.
- (2) Reduce $\frac{3}{121}$ and $\frac{7}{161}$ to decimals; ·2207 and ·390039 to vulgar fractions.
- (3) Find the value of ·2822265625 of a quarter, and reduce £4 2s. 1½d. to the decimal of £5.
- (4) Reduce $\frac{4}{33}$ and $\frac{5}{14}$ to decimals; ·8712 and ·9916 to vulgar fractions and find the value of ·7125 of 13s. 4d.
- (5) Find the value of £6 + ·27 of £1 13s. + 2·83 of 8s. — 1·25 of 2s. 6d.
- (6) Reduce 4 cwt. 2 qrs. 3 lbs. 8 oz. to the decimal of 1 ton; and if ·6 of 1 lb. cost £·625, what is the value of 3·83 lbs.?
- (7) Find the average of $\frac{7}{13}$, ·287, $11\frac{1}{24}$, 1·3419, ·325, $\frac{1}{3}$, 6·825, 1·25.
- (8) Find the value of ·006510416 of £4 + ·0015625 of £20 + ·013802083 of £8.
- (9) Find the value of ·3571428 of 1 ton; and ·72 of £1 2s. + 1·316 of 1s. 10d. — ·142857 of a guinea to the decimal of £10.
- (10) Reduce ·455877 and ·190476 to vulgar fractions; and 5 cwt. 2 qrs. 5 lbs. 4 oz. to the decimal of a ton.
- (11) Find the value of ·1083 of £2 10s. + ·761904 of a guinea + ·25 of 10s. + ·625 of a crown — ·125 of £10 5s.
- (12) Find the value of $3\frac{1}{4} + \frac{1}{2} + \frac{1}{12} + 3\frac{1}{8} + 2\frac{1}{3}$ both by vulgar fractions and by decimals, and show that the results coincide.
- (13) Find the difference between ·725 of 10s. and £·03; also between 2·0693 of 8s. 5d. and £·7416.
- (14) If ·25 of a lb. of tea cost ·83 of 1s., what is the value of 3·625 lbs.?
- (15) Find the value of ·2472 of an acre, and reduce the result to the decimal of 3a. 10p.
- (16) Multiply ·0012 by ·2564, and divide the result by ·00048.
- (17) Find the difference between ·07348 of 1a. 15p. and ·0045 of an acre; also between ·072 of a mile and ·0185 of 3 furlongs.
- (18) Find the value of ·3125 of £2 — ·016 of £1 10s. + ·714285 of 2 guineas — ·7083 of a crown.
- (19) Find the value of $3\frac{1}{4} + \frac{3}{14} + 1\frac{11}{28} + 6\frac{1}{3} + \frac{1}{21}$ both by vulgar fractions and by decimals, and show that the two results coincide.
- (20) How many yards of carpet 1·016 yds. broad will cover the floor of a room which is 42·7 yds. long and 19·00595238 yds. broad?
- (21) Find the value of 1·25 of ·16 of £2; and of 27·5 of 4·2718 of £3·5.

(22) If $1\frac{5}{8}$ of a ton of coals cost £1·087, what is the value of 7·142857 tons?

(23) Find the difference between ·0106 of £1 11s. 3d. and ·0025974 of £4 16s. 3d.; and reduce the result to the decimal of £1.

(24) Multiply ·1174 by ·0025; divide 2·304 by ·096, and reduce £3 10s. 4½d. to the decimal of £5.

(25) Multiply 3s. 1½d. by 7·124; and divide £414 15s. 0½d. by 6·31.

(26) Find the value of $\frac{25\cdot75 + 7\cdot5}{2\cdot87 + 11\cdot38}$ of £1·25 — ·87916 of £1 + ·40873016 of a guinea — 678321 of 11s. 11d.

(27) Find the value of ·857142 cwt. of sugar at ·4583s. per lb.; and what decimal of £5 is ·96d.?

(28) Find the value of ·5094339622641 of 8s. 10d.; and reduce 12. 4p. 16 yds. 7 ft. 18 in. to the decimal of an acre.

(29) Find the value of $\frac{3\cdot125}{1\cdot171875}$ of $\frac{4\cdot45}{1\cdot285714} + \frac{1\cdot2}{15\cdot125}$ of ·0625

(30) If an ounce of pure gold be worth £4·24772, what is the weight of a bar of gold worth £5·663?

(31) What decimal multiplied by the sum of $3\frac{1}{2}$, $6\frac{5}{8}$, $\frac{7}{18}$, $\frac{5}{8}$, will produce 29?

(32) Multiply 11·05 by ·0024; divide 270 by ·00073, and reduce £2 17s. 10½d. to the decimal of £5.

(33) Find the value of 9765625 of £8 10s. 8d., and of ·074894514767932 of 79 yds. of cloth.

(34) Reduce $\frac{12}{161}$ and $\frac{35}{8}$ to decimals; 1·527 and ·4769230 to vulgar fractions; and £2 7s. 3d. to the decimal of £5.

(35) Find the value of ·35769230 of £13 + ·615384 of 13s. + ·6904761 of 3s. 6d. — ·769230 of £2 12s.

(36) Find the values of $2\cdot54 + \cdot75 + \cdot125 + \cdot3$; $4\cdot7218 - 3\cdot54$; $\cdot846153 \times 117$; $\cdot4954 + 9\cdot90$; and find the product of the three last results.

(37) Find the value of ·45370 of 3 fur. 18p.; and ·1128472 of an acre.

(38) Find the value of $\frac{11\cdot05 - 6\cdot975}{1\cdot18 \text{ of } 1\cdot2} - \frac{6\cdot29 \text{ of } 2\cdot138}{7\cdot25 + \cdot083}$ of $\frac{8\cdot613 - 6\cdot213}{5\cdot6 \text{ of } \cdot46}$.

(39) Find the value $\frac{2}{3}$ of 2·4206349 guineas; and reduce the result to the decimal of 10s. 6d.

(40) Required the exact value of 3·857142 of 2 cwt. + 1·285714 of 3 qrs. + ·428571 of ·3 of a cwt. + 2·6 of ·714285 of 2·4 lbs.

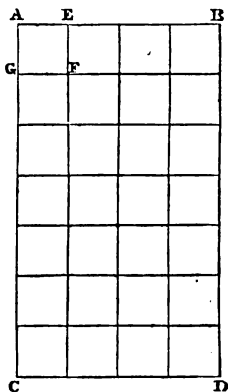
(41) If 1 oz. of gold is worth £4·24772, what is the value of a bar weighing 4 lbs. 3½ oz.?

(42) There is ·925 of pure silver in standard silver; how many pounds Troy of pure silver are there in 1 ton of standard?

(43) What will be the cost of papering a room, length 24.16 ft., breadth 17.138 ft., height 12 ft., at 3d. a sq. yd.; also laying down a carpet 22 in. wide, at 4s. 6d. a sq. yd.?

MENSURATION OF RECTANGULAR SURFACES AND SOLIDS.

Let $ABCD$ represent a rectangular surface, of which AB is 4 ft. and AC 7 ft. Divide the respective sides into 4 and 7 equal parts, and through the points draw lines parallel to AB and AC ; then $AEFG$ will be a square foot, as each side measures 1 foot, and all the similar figures will also be square feet. As AB is divided into 4 equal parts and AC into 7, the number of their squares will be $4 \times 7 = 28$. Hence the area of any rectangular surface is equal to the product of the sides. It is quite evident that if this was the surface of a solid 3 ft. thick, there would be three times as many solid as square feet. Hence the solid contents of a rectangular figure is equal to the length multiplied by the breadth multiplied by the thickness. A cube is a rectangular solid whose length, breadth, and thickness are equal.



Required the solid contents of a cube, each side of which is 4 feet. $4 \times 4 \times 4 = 64$ ft. solid contents. Find the area of a room which measures 16 ft. 8 in. by 14 ft. 3 in.

$$16 \text{ ft. } 8 \text{ in.} = 16\frac{2}{3} \text{ ft.} = \frac{50}{3}, \text{ and } 14 \text{ ft. } 3 \text{ in.} = 14\frac{1}{4} \text{ ft.} = \frac{57}{4}.$$

$$\frac{50}{3} \times \frac{57}{4} = \frac{475}{2} \text{ sq. ft.} = 237 \text{ sq. ft. } 72 \text{ in.}$$

The area might have been found by reducing both to inches.

$$\begin{array}{r}
 16 \text{ ft. } 8 \text{ in.} = 200 \text{ in.} \\
 14 \text{ ft. } 3 \text{ in.} = 171 \text{ in.} \\
 \begin{array}{r}
 25 \\
 50 \\
 200 \\
 \hline
 200 \times 171 \\
 \begin{array}{r}
 171 \\
 1408 \\
 3380 \\
 \hline
 34180
 \end{array}
 \end{array}
 = \frac{475}{2} = 237 \text{ ft. } 72 \text{ in.}
 \end{array}$$

The area may also be found by what is generally denominated duodecimals, but, as will be seen by the examples below, does not give the correct answer.

	ft.	in.		ft.	in.
(1)	16	8	(2)	4	7
	14	3		3	5
	<hr/>			<hr/>	
	233	4		13	9
	4	2		1	10 11
	<hr/>			<hr/>	
	237	6		15	7 11

In duodecimals a foot is supposed to be divided into 12 parts, a part into 12 seconds, and so on.

RULE.—Multiply each denomination of the multiplicand by the feet of the multiplier; divide by 12, and the remainder, if any, will be the same as the denomination multiplied; then multiply by the inches of the multiplier, divide by 12, and the remainder, if any, must be placed one place further to the right; next multiply by the parts, if any, divide by 12, and place the remainder, if any, a place still further to the right; each quantity multiplied must be divided by 12 except when you multiply feet by feet, which gives feet.

In all these examples we have the inches lineal instead of square. In Ex. 1 it should be 237 ft. 72 in. instead of 6 inches. In Ex. 2, $4\frac{7}{12} \times 3\frac{5}{12} = \frac{55}{12} \times \frac{41}{12} = \frac{2255}{144} = 15 \text{ ft. } 95 \text{ in.}$; working by duodecimals, we have 15 feet $7\frac{1}{2}$ lineal inches, which is 12 times too little, therefore, to get the true answer, the inches must be multiplied by 12, and the parts, &c. added.

Required the quantity of paper 22 in. wide, necessary to paper a room 10 ft. 6 in. high, 16 ft. 10 in. long, 14 ft. 6 in. wide.

16 ft. 10 in. + 14 ft. 6 in. $\times 2 = 62$ ft. 8 in. = perimeter.

$$62\frac{2}{3} \times 10\frac{1}{2} \times \frac{1}{2} \div (\frac{11}{8} \times \frac{1}{2}) = \frac{188}{3} \times \frac{21}{2} \times \frac{1}{8} \times \frac{8}{11} \times \frac{2}{1} = \frac{1316}{11} \text{ yds.} = 119\frac{7}{11}.$$

A plank is $4\frac{1}{2}$ in. thick, $6\frac{3}{4}$ in. broad; what length must be cut off to contain $4\frac{1}{2}$ cubic feet?

$$4\frac{1}{2} \div (4\frac{1}{2} \times 6\frac{3}{4} \times \frac{1}{144}).$$

$$\frac{8}{2} \times \frac{2}{8} \times \frac{4}{21} \times \frac{144}{1} = \frac{64}{3} \text{ ft.} = 21\frac{1}{3} \text{ ft.}$$

What will be the cost of a balk of timber 24 ft. long, 1 ft. 10 in. broad and 1 ft. 6 in. deep, at 2s. 9d. per cubic foot?

$$24 \times 1\frac{5}{8} \times 1\frac{1}{2} \times 2\frac{3}{4} = \frac{24}{1} \times \frac{11}{8} \times \frac{3}{2} \times \frac{11}{4} = \frac{363}{2} \text{ s.} = 181\frac{1}{2} \text{ s.} = £9 \text{ 1s. } 6\text{d.}$$

The diameter of a well is 3 ft. 9 in., the depth 32 ft.; what would be the cost of sinking at 5s. per cubic yard?

The area of a circle is equal to the diameter squared and multiplied by .7854 or $\frac{11}{14}$. The circumference is equal to the diameter multiplied by 3.1416 or by $\frac{22}{7}$.

$$3\frac{3}{4} \text{ ft.} = \frac{15}{4} \times \frac{15}{4} \times \frac{7854}{10000} \times \frac{32}{1} \times \frac{1}{27} \times \frac{5}{1} = \frac{1392}{20} = £3 \text{ 5s. } 5\frac{1}{2}\text{d.}$$

ft. 2	2000	8
3-75	400	11-0446875
3-75	80	32
<u>1875</u>	10	<u>220893750</u>
2625		331340625
<u>1125</u>		
14-0625		
<u>7854</u>		
562500		
703125		
1125000		
<u>984375</u>		
11-04468750		

$$27 \left\{ \begin{array}{l} 3) 353.4300000 \\ 9) 117.81 \\ \hline 13.09 \\ 5 \end{array} \right.$$

$$2,0) 6,5.45 = \frac{45}{100} \text{ s.} = \frac{9}{20} \text{ s.} = 5\frac{1}{2}\text{d.}$$

Ans. £3 5s. $5\frac{1}{2}$ d.

Making use of $\frac{11}{14}$ instead of .7854 considerably shortens the work, with but a slight alteration in the answer, viz. £3 5s. $5\frac{1}{2}$ d. instead of £3 5s. $5\frac{1}{2}$ d.

EXERCISE XLV.

- (1) 3 ft. 4 in. \times 8 ft. 7 in. (2) 6 ft. 4 in. \times 7 ft. 2 in.
 (3) 9 ft. 3 in. \times 8 ft. 7 in. (4) 6 ft. 9 in. \times 5 ft. 5 in.
 (5) 8 ft. 7 in. \times 9 ft. 6 in. (6) 12 ft. 7 in. \times 11 ft. 9 in.
 (7) 7 ft. 3 in. \times 8 ft. 9 in. (8) 5 ft. 11 in. \times 8 ft. 11 in.
 (9) 13 ft. $8\frac{1}{2}$ in. \times 7 ft. $11\frac{1}{4}$ in.
- (10) How much carpet 27 in. wide will cover a room 22 ft. 6 in. long, and 15 ft. 9 in. wide, and what will be the expense at 4s. 3d. a yard?
- (11) What will be the cost of painting a room at $9\frac{1}{2}$ d. per square yard whose height is 9 ft. 6 in., length 18 ft. 3 in., and width 20 ft.?
- (12) What will be the cost of paving a yard 78 ft. 9 in. long and 41 ft. 4 in. wide, at 2s. $9\frac{1}{2}$ d. per yard? and what number of stones will be required each 2 ft. 3 in. by 1 ft. 8 in.?
- (13) How many gallons of water (a gallon equal to 277.25 cubic inches) will a cistern hold which is 4 ft. 3 in. long, 3 ft. 6 in. wide, and 2 feet 8 in. deep? and what will be the weight of the water, a cubic foot weighing 1000 ounces?
- (14) What will be the cost of lining the above with lead which weighs 8 lbs. to the square foot at £1 18s. 6d. per cwt.?
- (15) A passage 24 yds. long, 4 ft. 6 in. broad, is to be covered with oilcloth; what will be the cost of the cloth at 3s. 3d. per sq. yd.?
- (16) A garden is 64 yds. 2 ft. long and $47\frac{1}{2}$ yds. wide; it is surrounded by a gravel path 5 ft. wide: required the dimensions of the garden and the dimensions of the path, and what would be the expense of gravelling the path, supposing 1 cart load would do 10 yards in length, the cost of gravel 3s. 9d. per load, and the cost of spreading 4d. per load.
- (17) What would the above garden cost for digging at $4\frac{1}{2}$ d. per rod?
- (18) A cubical box is covered with sheet lead which weighs 4 lbs. per square foot, and 384 lbs. of lead are used; what is the size of the box including the lid?
- (19) A plank is $11\frac{1}{4}$ in. wide, $4\frac{1}{2}$ in. thick; what quantity must be cut off to make $7\frac{1}{2}$ cubic feet?
- (20) The diameter of a well is 3 ft. 6 in., depth 20 ft. Required the expense of sinking at 4s. 9d. per cubic foot = (diam²) $\times \frac{11}{12} \times 20 \times 4\frac{3}{4}$.
- (21) Required the quantity of timber 9 in. broad and 1 in. thick necessary to make a box 5 ft. 6 in. long, 3 ft. 3 in. broad, 2 ft. 9 in. deep.
- (22) What is the cost of a block of stone 9 ft. 9 in. long, 2 ft. 9 in. broad, 1 ft. 4 in. deep, at 2s. 6d. per cubic foot?
- (23) How many acres, roods, poles, &c. are there in a rectangular field the length of which is 4375 links, and breadth 275 links?

(24) Required the cost of a piece of ground 98 ft. 4 in. long and 24 ft. 6 in. broad, at 3s. 9d. per square foot.

(25) What will be the cost of cutting a drain 81 feet long, 7 ft. 2 in. broad, and 7 ft. 6 in. deep, at 8d. per cubic yard?

(26) A cubical box is covered with sheet lead, which weighs 6 lbs. per square foot; 441 lbs of lead are used. What is the size of the box including the lid?

(27) What will be the cost of hewing all the faces of a stone 10 ft. 2 in. long, 5 ft. 6 in. broad, and 2 ft. 3 in. deep, at 6d. per square foot?

(28) How many bullocks would a shed contain which is 69 ft. 4 in. by 15 ft. 9 in., each bullock being allowed 21 square feet?

(29) The diameter of a well is 3 ft. 4 in. and its depth 40 feet; what did it cost sinking at 6s. 9d. per cubic yard?

(30) What will be the difference of the area of a pipe 3 feet in diameter, and two each 18 in. in diameter; and what would be the difference in the quantity of metal in 100 feet of pipe in both sets, supposing the 18 in. pipes to be $\frac{1}{2}$ in. thick and the 3 ft. pipe $\frac{3}{4}$ in. thick?

In this example find the area of the circle by multiplying the square of the diameter by $\frac{11}{14}$.

(31) Required the cost of building a wall 9 ft. high, $1\frac{1}{2}$ bricks thick, round a garden which is 127 yds. long, 74 yds. 2 ft. broad, at £9 the rod of brickwork (272 $\frac{1}{2}$ ft.); and what number of bricks would it take, each brick measuring 9 in. by $4\frac{1}{2}$ in. by $2\frac{1}{4}$ in.?

(32) The beams of wood used in building a house are 8 in. thick and 15 in. wide. Three hundred of them are used, which together amount to 9000 cubic feet. What is the length of each beam?

(33) A square iron rod, an inch thick and 18 inches long, weighs 5 $\frac{1}{2}$ lbs. How much would a round iron rod of the same length and thickness weigh? (Take $\frac{27}{8}$ as the ratio between diameter and circumference.)

(34) The legs of a right angled triangle are 24.5 and 40; required the hypotenuse.

(35) If the hypotenuse is 35 and the perpendicular 21, required the base.

(36) The side of a square is 6 ft.; what is its diagonal?

(37) A rectangular table is 7 ft. 6 in. long, and 3 ft. broad; what is the length of its diagonal?

(38) A line of 80 yards will reach from the top of a castle, which stands at the side of a river, to the opposite bank; required the breadth of the river, the height of the castle being 45 yds.

(39) A ladder 45 feet long, being placed in a street, will exactly reach to a window 36 ft. from the ground on one side; and, upon being turned

over without moving the foot, will reach a window 27 ft. high on the other side; required the breadth of the street.

(40) The legs of a right angled triangle are 56 and 42; required the perpendicular let fall upon the hypotenuse from the right angle.

(41) The diagonal of a square is 9 yds.; required the area.

(42) Find the area of a rectangle, whose base and diagonal are 72 and 90 yds.

(43) Required the area of an isosceles triangle, whose base is 96 yds. and each of the equal sides 80 yds.

(44) Required the area of an equilateral triangle, whose side is 12 yards.

PROPORTION.

Ratio is the number which expresses how many sets of the second number the first number contains, or what fraction of the second number the first number is. In other words, **Ratio** is the number of times or parts of a time that the first number mentioned contains the second, and may be expressed either as $3 : 4$, or $\frac{3}{4}$.

Proportion is a statement (made by the sign $::$) that the first ratio equals the second ratio. Since a proportion is a statement that two ratios are equal, and since every ratio may be represented by a fraction, any proportion, as $14 : 3 :: 46\frac{2}{3} : 10$, may be written $\frac{14}{3} = \frac{46\frac{2}{3}}{10}$; multiplying by the denominators 3 and 10, we have $14 \times 10 = 3 \times 46\frac{2}{3}$, or in any ratio the product of the extremes (outside terms) = the product of the means (inside terms).

Every question in Proportion or Rule of Three is a defective proportion, having the first ratio given, and the first term of the second ratio. It is required to complete the second ratio so as to make it equal to the first.

Let $17 : 5 :: 18 : ?$ be such a proportion, call the term required (for distinction's sake) x , then $17 : 5 :: 18 : x$.

Remembering that the product of the means = the product of the extremes, we have

$$5 \times 18 = x \times 17 \quad \text{or,} \quad 90 = x \times 17;$$

by this it is seen that 90 is 17 times as much as x ,
 $\therefore 90 \div 17 = x$, or $x = 5\frac{5}{17}$;

$\therefore 17 : 5 :: 18 : 5\frac{5}{17}$. Hence the multiplication of the 3rd term by the 2nd (to find the product of the means), and the division of this product by the first to find the required fourth term.

If 3 lbs. of sugar cost 9d. what will 10 lbs. cost?

It is quite clear that there must exist the same ratio between 3 lbs. and 10 lbs. as between the cost of 3 lbs. and the cost of 10 lbs. In other words, 10 lbs. must cost as many times more money than 3 lbs. as 10 lbs. is greater than 3 lbs. Putting this in the form of proportion, we have 3 lbs. : 10 lbs. :: 9d. is to the value of 10 lbs. or x , \therefore from the

$$\text{above } \frac{10 \times 9}{3} = x = 30d. = 2s. 6d.$$

Again, if 3 lbs. cost 9d. what will 10 cwt. cost?

In this instance 3 lbs. will have the same ratio to 10 cwt. as 9d. has to the value of 10 cwt. To express the ratio correctly the quantities must be in the same denomination, consequently the 10 cwt. must be reduced to lbs.

$$3 \text{ lbs.} : 10 \text{ cwt.} \times 112 :: 9d. : x.$$

$$\frac{10 \times 112 \times 9}{3} = 3360d. = £14 \text{ } 0s. \text{ } 0d.$$

If the tax on a rent of £50 be £4 10s. what will it be on £20 8s. 4d.?

In this instance it is evident that the same ratio will exist between £50 and £20 8s. 4d. as between the tax on £50 and that on £20 8s. 4d.

$$£50 \times 20 \times 12 : £20 \text{ } 8s. \text{ } 4d. :: £4 \text{ } 10s.$$

$$\begin{array}{r} 20 \\ 408 \\ 12 \\ \hline 4900 \end{array} \quad \begin{array}{r} 20 \\ 90 \end{array}$$

$$\begin{array}{r} 49 \\ 245 \\ 3 \\ \hline 4900 \times 80 \\ 80 \times 20 \times 12 \\ \hline 147s. \\ 4 \end{array} = £1 \text{ } 16s. \text{ } 9d.$$

If 10A. 3R. are rented for £17 4s. what will be the rent of 326A. 2R. 25P.?

Here the ratio between 10A. 3R. and 326A. 2R. 25P. is the same as the ratio between £17 4s., the price of 10A. 3R., and the price of 326A. 2R. 25P.

$$10A. 3R. : 326A. 2R. 25P. :: £17 \text{ 4s.}$$

$$\begin{array}{r} \frac{4}{43 \times 40} \quad \frac{4}{1306} \quad \frac{20}{344} \\ \hline 40 \\ \hline 52265 \end{array}$$

$$\begin{array}{r} 10453 \quad 8 \\ 52265 \times 344 \\ \hline 48 \times 40 \\ \hline 8 \end{array} = 10453s. = £522 \text{ 13s.}$$

If a bankrupt's assets are £324 12s. 6d., and he pays 2s. 8d. in the pound, what are his liabilities?

As the bankrupt can pay only 2s. 8d. instead of £1, and £324 12s. 6d. instead of his real debts, it is evident that 2s. 8d. will bear the same ratio to £324 12s. 6d. as £1 does to his real debts or liabilities.

$$2s. 8d. : £324 \text{ 12s. 6d.} :: £1 \times 20 \times 12.$$

$$\begin{array}{r} \frac{12}{32} \quad \frac{20}{6492} \\ \hline 12 \\ \hline 77910 \end{array}$$

$$\begin{array}{r} 38955 \quad 5 \quad 3 \\ 77910 \times 20 \times 12 \\ \hline 82 \\ \hline 8 \\ \hline 2 \end{array} = 584325d. = £2434 \text{ 13s. 9d.}$$

If a bankrupt's liabilities are £2059 13s. 9d., and his assets amount to £274 12s. 6d., what will he pay in the pound?

As the bankrupt pays £274 12s. 6d. instead of £2059 13s. 9d. it is required to find what he will pay instead of £1; therefore his entire debts of £2059 13s. 9d. bear the same ratio to £1 as what he pays, viz. £274 12s. 6d., does to what is paid in £1.

$$£2059\ 13s.\ 9d. : £1 \times 20 \times 12 :: £274\ 12s.\ 6d.$$

$\begin{array}{r} 20 \\ 41193 \\ 12 \\ \hline 494325 \end{array}$	$\begin{array}{r} 20 \\ 5492 \\ 12 \\ \hline 65910 \end{array}$
---	---

$$\begin{array}{r} 4 \quad 4 \quad 2 \\ 20 \times 12 \times 55810 \\ \hline 484325 \\ 33335 \\ 32955 \end{array} = 32d. = 2s.\ 8d.$$

From these examples it will be seen that in every proportion the same ratio must exist between the two like quantities as there does between the unlike and the one required, and this will be found quite sufficient rule for working all examples in Proportion.

The more **Common Rule** is as follows. Put the term which is of the same kind as the answer in the third place; then judge from the nature of the question whether the answer will be greater or less than the third term; if greater, put the greater of the two remaining terms in the second place, and if less, the smaller of the two remaining in the second place; in each instance the remaining term in the first place.

It is most important, in training the mind, to dispense with set rules, and to exercise the pupil in solving arithmetical problems on **First Principles**, in other words, to adopt what is generally termed the *Unitary System*. This may be advantageously applied to Proportion, Profit and Loss, Interest, Stocks, &c.

If a bankrupt's assets are £524 13s. 3d., and his liabilities £3147 19s. 6d. what will he pay in the £?

The assets paid on £3147 19s. 6d. are £524 13s. 3d.

$$\text{The assets paid on } £1 = \frac{£524\ 13s.\ 3d.}{£3147\ 19s.\ 6d.} = \frac{125919}{755514} = £\frac{1}{3} = 3s.\ 4d.$$

If the tax on a house rented at £45 be £3 7s. 1d. what will it be on one rented at 75 guineas?

The tax on £45 is £3 7s. 1d. or 805d.

∴ the tax on £1 = $\frac{805}{45} = \frac{161}{9}$.

∴ the tax on £78 15s. = $\frac{161}{9} \times 78\frac{3}{4} = \frac{161}{9} \times \frac{315}{4} = \frac{5235}{4}d. = £5\ 17s.\ 4\frac{3}{4}d.$

If 3 cwt. 2 qrs. 16 lbs. of coffee cost £35 14s. what would 7 lbs. cost?

The cost of 3 cwt. 2 qrs. 16 lbs. is £35 14s. or 714s.

∴ the cost of 1 lb. will be £35 14s. divided by 3 cwt. 2 qrs. 16 lbs. reduced to lbs., or $\frac{714}{464} = \frac{7}{4}s.$ ∴ cost of 7 lbs. = $\frac{7}{4} \times \frac{7}{1} = \frac{49}{4}s. = 12s.\ 3d.$

EXERCISE XLVI.

- (1) If 36 acres are let for £48, what will be the rent of 54 acres?
- (2) If I lend my friend £540 for 10 months, how long ought he to lend me £900 to requite the kindness?
- (3) If 328 cwt. cost £984, how many cwt. may be bought for £246?
- (4) If 615 gallons of wine cost £545, what will 984 gallons cost?
- (5) If by working 10 hours a day a man can finish a piece of work in 18 weeks, how long will it take him to finish it working 9 hours a day?
- (6) If a person whose income is £700 a year pays an income tax of £17 10s., what is that in the pound?
- (7) If 80 lbs. of sugar cost £2 15s. 4d., what will be the cost of 20 lbs.?
- (8) If a clerk receives 33 guineas for 11 weeks' service, how long ought he to serve for £189?
- (9) If 81 lbs. of sugar cost £1 17s. 6 $\frac{3}{4}$ d., what will 27 lbs. cost?
- (10) If the coach fare for 224 miles be £4 13s. 4d., how far ought one to go for £5 2s. 6d.?
- (11) What will be the cost of 17 cwt. if 3 lbs. 6 oz. cost 2s. 9 $\frac{3}{4}$ d.?
- (12) Find the cost of 1 lb. of cochineal at 97 guineas per cwt.
- (13) If 1 cwt. 2 qrs. 14 lbs. of rice cost £1 6s. 3d., how much may be bought for £186 15s.?
- (14) An express train travels at the rate of 63 miles an hour: what distance does it pass over in a second?
- (15) What will be the tax paid on £1356 at 4s. 7 $\frac{1}{2}$ d. in the pound?
- (16) In what time will a ship complete a voyage of 5236 miles at the average rate of 14 feet per second?
- (17) If 4592 children can be maintained for £14732 1s. 4 $\frac{1}{2}$ d. per annum, for how much per annum can 3920 children be supported?
- (18) If a pressure of 19 lbs. 11 oz. the square inch will enable a

steam engine to raise 5730 gallons of water, how much can it raise with a pressure of 27 lbs. 9 oz. the square inch?

(19) If 7 tuns of wine cost £1256 17s. find the price per quart.

(20) Find the value of 12 cwt. 3 qrs. 24 lbs. of tea at 5s. 4½d. the lb.

(21) What will be the cost of 225,216 cubic feet of gas when 13,248 cubic feet cost £77 1s. 4d.?

(22) If 205,128 trees are sufficient to plant 116 acres 2 roods 8 poles of land, for how much land will 2549 dozen and 3 trees suffice?

(23) The malt necessary for brewing 121 bar. 29 gals. 2 qts. costs £36 14s. 1½d. what will be the cost of the malt required for brewing 69 bar. 22 gals.?

(24) If 1 bushel of potatoes is worth 2s. 8d., what will be the value of 10 rows, each yielding 2 bushels 3 pecks, the cost of digging being 2d. per row?

(25) A farmer who has 57A. 3R. 12P. of wheat finds that it yields an average of 4 quarters 5 bushels 2 pecks per acre. How much wheat does he grow, and what is it worth at 26s. 8d. per quarter?

(26) A borrowed of B £85 8s. for 105 days, and afterwards would return the favour by lending B the sum of £320 5s.; for how long should he lend it?

(27) How much land may be rented for £327 18s. if 11A. 1R. are rented for £13 10s.?

(28) If the carriage of 5 tons 17 cwt. is 9s. 9d. for 20 miles, what will be the carriage of 3 tons for the same distance?

(29) What is the tax on a house rented at 125 guineas if that on one rented at 45½ guineas be £7 19s. 3d.?

(30) If 152 sacks will hold 65 quarters 2 bushels 2 pecks, how many sacks will contain 18 quarters 7 bushels 1 peck?

(31) If a wedge of gold weighing 1 lb. 9 oz. cost £81 14s. 6d., what is that per oz.?

(32) If 81A. 3R. 15P. of land cost £577 2s. 6d., what is the value of 13A. 3R. 31P.?

(33) A piece of land 10 yds. 4 in. long and 9 yds. 1 ft. broad is exchanged for another piece 74 yds. 2 ft. long; how broad ought this to be, to contain the same space?

(34) If a stick 3 ft. 1½ in. long throws a shadow 12 yds. 1 ft. 8 in. in length, what is the height of a church tower which throws a shadow of 817 yds. 0 ft. 8 in.?

(35) The cost of a railway 122 miles 3 furlongs 16P. 3 yards 2 feet long is £538679 3s. 4d.; what will be the cost of one 5 miles 10 poles?

(36) Find the cost of 32 cwt. 0 qr. 1 lb. of sugar when £388 16s. is given for 25 tons 18 cwt. 2 qrs. 5 lbs.

(37) If 15 cwt. 3 qrs. 9 lbs. 3 oz. cost £33 15s. 6d. what will 4 tons cost?

(38) A besieged fortress has provisions for 207 weeks, at the rate of 15 ozs. a day for each man; at what rate per day must the provision be distributed, so that the place may hold out 345 weeks?

(39) A gentleman who has property on a building lease which produces him a rental of £3285 pays a land tax of £9 15s. per £100; what is his net income?

(40) If a railway fare for 126 miles is £1 7s. 9d., what will be the fare for 287 miles at the same rate?

(41) The expenses of the poor of a parish amount to £348 1s. 6d., and the entire rental amounts to £6426; what must be levied in the £ to pay it?

(42) What will be the cost of 2 tons 13 cwt. 3 qrs. if 5 cwt. 1 qr. 13 lbs. 9 oz. cost £9 3s. 4d.?

(43) What amount of poor rates must be paid by a person who is rented at 146½ guineas when that on a rental of £93 19s. 6d. is £4 9s. 6d.?

(44) The expenses of the poor in a parish amount to £220 4s. 2d. and the whole rental is £3020; how much in the pound must be levied to pay it?

(45) What will be the rent of 856A. 3R. 24P. if the rent of 7A. be £8 15s.?

(46) What is the amount of poor rates to be paid upon £357 7s. 3d. when £41 10s. 8d. is levied upon £456 17s. 4d.?

(47) If 86 cwt. 1 qr. 9 lbs. cost £89 6s. 7d., how much must be given for 7 cwt. 3 qrs. 11 lbs.?

(48) What will be the income tax on £6426 15s. at 7d. in the pound?

(49) If 3 yards of silk cost £1 3s. 3d., what will be the cost of 6 bales, each measuring 126 yds. 2 qrs. 2 nls.?

(50) A bankrupt owes £6862 2s. 6d., and his whole property amounts to £228 14s. 9d., what dividend will his creditors receive in the pound?

(51) If the tax on a rent of £66 is £5 10s., what will it be on £44?

(52) If a man could walk 5 miles 7 fur. 137 yds. in 1 hr. 20 mins., how long would it take him to walk 23 miles 1428 yds. at the same rate?

(53) What is the amount of poor rates to be paid on £87 10s. when £31 10s. is levied upon £4725?

(54) How much will a creditor receive on a debt of £3265 17s. 9d. when a bankrupt can only pay 11s. 8d. in the pound?

(55) What is the tax on a house rented at £70 16s. 8d. if that on one rented at £50 be £8 8s.?

(56) If the duty on goods weighing 2 tons 6 cwt. 3 qrs. 14 lbs. be £4 13s. 9d., what is that per cwt.?

(57) The expenses of the poor in a parish amount to £540 3s. 9½d., the whole rent is £3221; how much in the pound must be levied to pay it?

(58) If one ounce of gold be worth £3 17s. 8d., what will be the value of a bar weighing 12 lbs. 7 oz. 11 dwts. 6 grs.?

(59) If a nobleman's rental be £10,000, and the land tax be charged at the rate of £3 12s. 6d. per £100, what will be his net income?

(60) If a poor rate of £10 14s. 6d. is paid on a rental of £122 10s. 3d. what will be the rate on a rental of £99?

(61) The carriage of 8 tons 5 cwt. 3 qrs. 21 lbs. for a distance of 180 miles is £2 8s. 10½d., what will be the carriage of 4 tons 19 cwt. 2 qrs. 7 lbs. for the same distance?

(62) Find the value of 3 tons 6 cwt. 1 qr. 14 lbs. of sugar when 5 tons 10 cwt. 2 qrs. 14 lbs. cost £46 8s. 10½d.?

(63) What must be given for 7 lbs. 1 oz. 9 dwts. 14 grs. of gold when 3 lbs. 6 oz. 14 dwts. 19 grs. cost £181 3s. 10½d.?

(64) The wages of a servant for 10 years 13 days are £290 19s., what will be due to him for a service of 333 days?

(65) A power of 6 cwt. 1 qr. 2 lbs. applied to a crane will raise a weight of 73 tons 11 cwt. 2 qrs. 27 lbs.; what power will be required to raise a weight of 13 tons 12 cwt. 2 qrs. 5 lbs.?

(66) If a bankrupt pays £16 9s. 7d. for a debt of £79 2s., what is that in the pound?

(67) The rateable value of a parish amounts to £4671, and a poor rate of £86 10s. is to be raised; what will a person have to pay whose rent is £1566?

(68) A bankrupt's assets are £3363 15s. 3d., and he owes £12814 6s. 8d. What will his estate pay in the pound?

(69) What is the income of a person who pays £12 15s. 6d. income tax at 4d. in the pound?

(70) If a druggist makes up 2 oz. 6 drs. 2 sc. 8 grs. of quinine in 76 days, how long will 3 lbs. last him? and what will be the cost at 15s. 8d. per ounce.

(71) The expenses of the poor in a parish amount to £186 8s. 4d., and the whole rent is £2796 5s.; how much in the pound must be levied to pay it?

(72) If one ounce of silver be worth 4s. 10d., what will be the cost of 53 lbs. 4 oz. 2 dwts. 12 grs.?

(73) If 201 men can perform a piece of work in 84 days, in how many days will 938 men do the same?

(74) If a swimmer at each stroke advance 4 feet, how many strokes would he make in a mile? and how long would it take him to swim that distance supposing he makes 110 strokes in 3 minutes?

(75) In an edition of Locke's Essay, containing 1120 pages, the second book begins at the 125th page: at what page will it begin in an edition which contains 1344 pages?

(76) If 20500 bricks are required to build a wall $866\frac{1}{2}$ feet long, how many will be required for one that is 404 yds. 0 ft. 9 in. in length?

(77) What is the income corresponding to an income tax of £85 7s. 11d. at the rate of 5d. in the pound?

(78) If the tax on a rent of £61 6s. 8d. is £4, what will it be on a rent of £23?

(79) If 120 tons 13 cwt. 2 qrs. 16 lbs. cost £1548 15s. 1d., what will 4 tons cost?

(80) What quantity of tea may be bought for £1092 when 1 cwt. 3 qrs. 16 lbs. cost £22 8s.?

(81) An ingot of silver weighing 9 lbs. 8 oz. 2 dwts. is valued at £9 13s. 6d.; what is the value of 4 lbs.?

(82) What is the income corresponding to an income tax of £15 16s. 8d. at the rate of 4d. in the pound?

(83) What is the tax on a house rented at £70 13s. 4d. if that on one rented at £30 be £5 6s. 8d.?

(84) If a pocket of hops weighing 2 cwt. 1 qr. 12 lbs. cost £8 13s. 3d. what is that per cwt.?

(85) What is the amount of poor rates to be paid upon £212 10s. when £70 16s. 8d. is levied on £2125?

(86) From 5 tons 7 cwt. 1 qr. 11 lbs. 10 oz. take 2 tons 9 cwt. 1 qr. 19 lbs. 2 oz., and find the value of the remainder at £1 17s. 4d. per cwt.?

(87) If the tax on a rent of £751 6s. 8d. is £60 13s. 4d., what will be the tax on £80 10s.?

(88) What will be the cost of 2 tons 10 cwt. 1 qr. 14 lbs. 14 oz. if 1 cwt. cost £2 13s. 4d.?

(89) What will be the value of 700 bales of cotton each weighing 1 cwt. 1 qr. 18 lbs. at £13 10s. 4d. per cwt.?

(90) A bankrupt's effects are worth £814 13s. 8d.; what will his creditors have in the pound when his debts amount to £3258 14s. 8d.?

(91) A steam vessel which moves at the average rate of 7 miles an hour performs a voyage in 101 days 12 hrs.; in what time will a vessel moving at the rate of 12 miles an hour perform the same voyage? and what distance will it have travelled?

(92) If a carrier pigeon flies $17\frac{1}{2}$ miles in 15 minutes, how long will it be in travelling from London to Paris, a distance of 210 miles?

(93) If 20 French mètres are equal to 3 poles 5 yds. 1 ft. $1\frac{1}{2}$ in. what is the length in English inches of each mètre? and how many French mètres are there in the mean diameter of the earth which is equal to 7912 miles?

(94) The speed of the hare is calculated to be 80 ft. per second, what will this be per hour?

(95) The paddle wheels of a steamship revolve 7310 times in 2 hrs. 1 min. 48 seconds, in what time will they make 10965 revolutions?

(96) A ship's cargo weighing 90 tons 8 cwt. displaces 108 tuns 1 hgshd. 24 gals. (wine measure) of water; how much water would be displaced by a vessel's cargo weighing 361 tons 12 cwt.?

(97) A haystack containing 1665 cubic yds. 13 ft. weighs 5 tons 8 cwt. 1 qr. 20 lbs.; what will be the weight of one which contains 94 cubic yds. 17 ft.?

(98) If 11880 soldiers consume 9 cwt. 3 qrs. 13 lbs. of powder in a review, how much was used by 4752 soldiers?

(99) If a locomotive engine making 35000 strokes per hour travels 55 miles 1088 yds. how far will an engine making 6250 strokes the hour travel in the same time?

(100) What is the amount of poor rates to be paid upon £100 16s. when £50 16s. 8d. is levied upon £1708?

(101) What is the income corresponding to an income tax of £30 8s. 4d. at the rate of 4d. in the pound?

(102) If a ton of potatoes cost £7 4s., what will be the cost of 35 lbs.?

(103) The rateable value of a parish amounts to £4502 8s., and the poor rate of £90 10s. is to be raised; what will a person have to pay whose rent is £1876?

(104) If the tax on a rent of £5206 5s. is £416 10s., what will be the tax on £3675?

(105) If a man can mow 3A. 1R. 16P. 11 yards in 4 days 6 hours 5 minutes, how long will it take him to mow 5A. 2R. 12P. 22 yards?

(106) What is the tax on a farm rented at £703 8s. 6d. if one rented at £1406 17s. be £234 9s. 6d.?

(107) If the tax on a rent of £331 2s. 6d. is £21 12s. 6d., what will it be on a rent of £110 7s. 6d.?

(108) What is the tax on a house rented at £18 10s. 6d. when £3 9s. is levied on one rented at £55 11s. 6d.?

(109) If a farmer pays at the rate of 22s. 6d. per acre for 563A. 3R. 16P., and sublets 140A. 3R. 34P., at 25s. 10d. per acre, taking

into consideration his gain of 3s. 4d. per acre, what will the entire farm stand him in per acre; and what will be his gain on the portion sublet?

(110) If 1A. 3R. will feed 7 sheep for 4 months, what quantity of land will be required to feed a flock of 500 sheep for the same time; and if the 7 sheep cost £1 3s. 4d. for 10 weeks, what will the flock cost per year; and what will be the value of the wool if each sheep's averages 4 lbs. 8 oz., at 2s. 2d. per pound?

(111) What must be paid for $13\frac{3}{4}$ lbs. Av., at $\frac{2}{3}$ s. for $\frac{1}{2}$ a lb.?

(112) What is the value of $14\frac{1}{2}$ cwt., at £6 14s. 4d. per $3\frac{1}{4}$ cwt.?

(113) If I lend my friend £461 14s. for $4\frac{1}{2}$ months, how long ought he to lend me £330 $\frac{1}{2}$ to return the kindness?

(114) What must be paid for $14\frac{1}{8}$ French ells, at £9 $\frac{1}{2}$ for $7\frac{1}{2}$ yds.?

(115) If $\frac{4\frac{1}{2}}{9}$ of a mine be worth £976 $\frac{1}{2}$, what will $\frac{7}{12}$ of $\frac{2}{3}$ of $\frac{6}{7}$ of 3 be worth?

(116) Sound travels at the average rate of $12\frac{3}{4}$ miles per minute; in what time will the sound of thunder, from a cloud $3\frac{37}{176}$ miles distance, reach us?

(117) If 8470 men can make a road in 2 yrs. 161 dys., in what time can 12705 men make it?

(118) If 102 tuns 1 pipe 42 gals. of wine cost £1025 9s. 3 $\frac{1}{2}$ d., what is the value of 10 tuns 1 pipe 42 gals.?

(119) A certain number of bricks will build a wall 31 ft. 8 in. high and 1129 yds. 1 ft. long; how high can a wall be built with the same number of bricks whose length is 1411 yds. 2 ft.?

(120) A tax of £48 10s. 9 $\frac{3}{4}$ d. is paid for an income of £4571 12s. 8 $\frac{1}{2}$ d.; what will be the tax on one of £870 15s. 9d.?

(121) If $\frac{1}{2}$ of a ship is worth £1026 $\frac{1}{2}$, what will $\frac{1}{3}$ be worth?

(122) If the rent of $2\frac{2}{3}$ roods be £ $\frac{2}{3}$, what will be the rent of $12\frac{3}{8}$ acres?

(123) If 25 $\frac{2}{3}$ s. will pay for the carriage of 1 cwt. for $145\frac{1}{2}$ miles, how far may $6\frac{1}{2}$ cwt. be carried for the same money?

(124) If 92 cwt. 2 qrs. $2\frac{5}{7}$ lbs. cost £863 $\frac{1}{4}$, what must be paid for $15\frac{3}{4}$ lbs.?

(125) What is the value of $416\frac{1}{8}$ cwt. at $\frac{7}{8}$ s. for $\frac{4}{5}$ lbs.?

(126) If $3\frac{1}{2}$ oz. of silver cost $14\frac{7}{8}$ shillings, what must be paid for $3\frac{1}{7}$ lbs.?

(127) What must be paid for $14\frac{1}{8}$ French ells, at £1 $\frac{3}{8}$ for $\frac{3}{4}$ of a yard?

(128) If $\frac{11\frac{3}{8}}{29}$ of $\frac{4\frac{1}{2}}{4\frac{1}{2}}$ of $\frac{3\frac{1}{2}}{10\frac{5}{8}}$ of 34 lbs. of tea cost 12s. 9d., what will 26 $\frac{3}{8}$ chests, each weighing 84 lbs., cost?

(129) What is the value of $136\frac{1}{7}$ cwt. at $\frac{7}{8}$ s. for $\frac{2}{5}$ lbs.?

(130) If $\frac{2}{3}$ of an estate be worth £1843 $\frac{4}{5}$, what is the value of the whole?

- (131) What must be given for 47A. 20P. at £49 18s. 4d. for $1\frac{1}{2}$ acres?
 (132) What is the value of $93\frac{1}{8}$ lbs. at £224 $\frac{5}{8}$ for $1\frac{1}{2}$ tons?
 (133) If $3\frac{1}{2}$ English ells cost £7 12s. 2d., what must be paid for $23\frac{1}{2}$ Flemish ells?

(134) A merchant who possessed $\frac{1}{8}$ of a ship, sold $\frac{2}{5}$ of his share for £1486 $\frac{1}{2}$; what was the value of the whole?

(135) If $\frac{9\frac{7}{8}}{2\frac{1}{27}}$ of $\frac{5\frac{3}{11}}{2\frac{7}{11}}$ of $\frac{1}{16}$ of a ship cost £400 6s. 5d., what will $\frac{1\frac{7}{10}}{10\frac{1}{8}}$ of $\frac{8\frac{1}{4}}{3\frac{5}{8}}$ of 3 cost?

(136) If $\frac{1}{8}$ of $\frac{1}{4}$ of $\frac{5}{8}$ of $\frac{7}{10}$ of $\frac{2}{3}$ of $\frac{10}{5}$ of 50 lbs. of tea is worth 6s., what is 8 cwt. 2 qrs. 8 lbs. worth?

(137) If $\frac{2}{3}$ of $\frac{2}{3}$ of 8 tons of coal cost 2 guineas, what will $\frac{2}{38}$ of it cost?

(138) If $14\frac{2}{3}$ of $4\frac{2}{3}$ of $\frac{2}{7}$ of 10 cwt. of sugar cost £172 16s., what is the cost per lb.?

(139) If $\frac{12}{28}$ of $\frac{2}{3}$ of $\frac{1}{8}$ of $\frac{4}{7}$ of $\frac{5}{9}$ of 121 of $\frac{4}{11}$ of $\frac{1}{24}$ of $\frac{13}{19}$ of $\frac{1}{14}$ of 1 cwt 14 lbs. of tea cost £11 4s., what is the value of a ton?

(140) If $\frac{7}{8}$ of $\frac{2}{11}$ of $\frac{1}{13}$ of $\frac{15}{17}$ of $\frac{232}{17}$ of $\frac{13}{15}$ of $\frac{135}{14}$ lbs. of butter cost £3 18s. $1\frac{1}{2}$ d., what is the price per lb.?

(141) If $\frac{4}{5}$ of $\frac{1}{2}$ of $\frac{16}{89}$ of $\frac{243}{501}$ of $\frac{227}{458}$ of $\frac{1802}{5}$ of $\frac{5}{152}$ of 25 oz. of gold is worth £36, what is the value of 60 lbs.?

(142) If $\frac{2}{3}$ of $\frac{2}{3}$ of $\frac{2}{11}$ of $5\frac{1}{3}$ of $1\frac{1}{8}$ of $3\frac{2}{3}$ of $2\frac{1}{2}$ of 5 lbs. of tea cost £7 17s. 6d., what will $\frac{1}{5}$ of $\frac{2}{11}$ of $\frac{13}{18}$ of $\frac{2}{13}$ of $14\frac{2}{3}$ of 2 of 3 lbs. of tea cost?

(143) If $\frac{4}{5}$ of $\frac{2}{23}$ of $\frac{5}{313}$ of $\frac{8}{15}$ of $\frac{10}{113}$ of $\frac{1}{3}$ of 3 cwt. of sugar cost £33 12s., what will $\frac{7}{13}$ of $\frac{11}{10}$ of $\frac{8}{11}$ of $\frac{23}{3}$ of 2 lbs. of sugar cost?

(144) A water-wheel, 22 ft. in circumference, is 7 ft. in diameter what is the circumference of one the diameter of which is 6 ft. $7\frac{1}{2}$ in.?

(145) A gentleman's estate brings in annually £7934 4s. 8d.; he pays his steward yearly £268 18s. 11d.; what is his monthly income, of four weeks to the month?

(146) A licitor bought 42 bundles of fascies, each containing 11 rods, at the rate of 84 rods for 12 denarii; what is their value in English money, if 7 denarii equal 4s. 2d.?

(147) A water-wheel, 7 ft. in diameter, is 22 ft. in circumference; what is the diameter of a wheel measuring 31 yds. 2 ft. 4 in. round?

(148) If 56 yds. 3 qrs. 2 nls. of carpet 3 qrs. wide cover a room that is 22 ft. 6 in. long, what is the width of the room, and what will be the cost of the carpet at 4s. 8d. per yard?

(149) If $\frac{1}{2}$ of $\frac{2}{3}$ of $1\frac{1}{2}$ of $\frac{7}{8}$ of $2\frac{1}{4}$ of $\frac{1}{3}$ of $1\frac{2}{3}$ of $\frac{2}{3}$ of a ship be worth $\frac{1\frac{1}{2}(7 + \frac{2}{3} + \frac{2}{3})}{12(1\frac{1}{2} + 2\frac{1}{2} + 3\frac{1}{2})}$ of £50, what is the whole worth?

(150) If $\frac{7}{3} + \frac{20}{7}$ of $\frac{5}{35}$ of an estate be worth £5000,
 $3 + 2\frac{1}{2} + 2\frac{1}{3}$ $7 + 3\frac{2}{3} + 4\frac{1}{2}$
 what is $\frac{5}{8}$ of $\frac{7}{8}$ of $\frac{5}{7}$ worth?
 $\frac{5}{8}$ of $\frac{5}{8}$ of $\frac{2}{3}$

(151) A garrison of 5000 men has provisions for six months; if after two months 2000 are sent away, and half as much more provisions as the then existing stock brought in, for what period will the garrison be victualled?

(152) If 38013 sq. yds. 60 sq. in. of glass are sufficient for 4512816 panes of glass, how much will be required for 5427576 panes, and what will be the cost of it at 9d. per sq. ft.?

(153) The weight of 5732 reams 17 quires 18 sheets of paper is 3 cwt. 3 qrs. 17 lbs. 10 oz.; what is the weight of 28695 reams 11 quires of paper, and what is the value of it if 12 sheets are sold for 2½d.?

(154) If an engine throws 10,000,000 gals. of water into the New River in 5 days, how many galls. will it throw in from May 1st to September 21st inclusive; what will be the weight of the water, supposing 10 galls. to contain 2772½ cub. in., and the weight of a cubic ft. to be 1000 oz.; and supposing the pump to be 15½ miles from the reservoir, and the width of the river to average 20 ft., how much will each day's pumping increase the depth of the river?

(155) What would be the depth of a reservoir to hold the water pumped from May 1st to September 21st in the preceding example, supposing it to be 1026 yds. 2½ ft. long, and 416 yds. 2 ft. broad; and how long would the water in the reservoir last a town of 40,000 inhabitants, supposing each person to consume 10 gals. per day?

COMPOUND PROPORTION.

Compound Proportion is nothing more than the combination of two or more Simple Proportion sums of which the term, which is of the same kind as the quantity required, is the common 3rd term for each statement.

If 7 men can mow 21A. of grass in 4 days, working 12 hrs. a day, how many men would mow 72A. in 8 days, working 9 hrs. a day?

Reducing this example into separate proportion sums, we may express it as follows:—

If 7 men can mow 21A. in a certain time, how many men will mow 72A. in the same time?

If 7 men can mow a certain quantity in 4 days, how many men can mow the same quantity in 8 days?

If 7 men can mow a certain quantity, working 12 hrs. a day, how many men will be required to mow the same quantity, working 9 hrs. a day?

From these examples we can get the three separate statements:

$$\begin{array}{lll} 21A. & : & 72A. \\ 8 \text{ dys.} & : & 4 \text{ dys.} \\ 9 \text{ hrs.} & : & 12 \text{ hrs.} \end{array} \left. \begin{array}{l} :: \\ :: \\ :: \end{array} \right\} 7 \text{ men.}$$

$$\frac{21 \times 4 \times 12 \times 7}{21 \times 8 \times 9} = 16 \text{ men.}$$

If 6 men can dig a trench 80 ft. long, 4 ft. 3 in. broad, and 4 ft. 6 in. deep in 10 days, working 9 hrs. a day, how long will it take 11 men to dig a trench 120 ft. long, 5 ft. 6 in. broad, and 4 ft. 3 in. deep, working 10 hrs. a day?

Reducing the above into separate examples, we have—

If a certain number of men can dig a trench 80 ft. $\times 4\frac{1}{2} \times 4\frac{1}{2}$ in 10 dys., how long will it take the same number of men to dig a trench 120 ft. $\times 5\frac{1}{2} \times 4\frac{1}{2}$?

If 6 men can dig a trench in 10 dys., how long will it take 11 men to dig the same?

If a certain number of men can dig a trench in 10 dys., working 9 hrs. a day, how long will it take them to dig it working 10 hrs. a day?

The above examples may be reduced to the following form:—

$$\begin{array}{lll} 80 \text{ ft.} \times 4\frac{1}{2} \times 4\frac{1}{2} & : & 120 \text{ ft.} \times 5\frac{1}{2} \times 4\frac{1}{2} \\ 10 \text{ hrs.} & : & 9 \text{ hrs.} \\ 11 \text{ men} & : & 6 \text{ men} \end{array} \left. \begin{array}{l} :: \\ :: \\ :: \end{array} \right\} 10 \text{ dys.}$$

$$\frac{80 \times 4 \times 10 \times 6 \times 9 \times 11 \times 11}{8 \times 11 \times 9 \times 10 \times 11 \times 6 \times 4} = 9 \text{ days.}$$

EXERCISE XLVII.

- (1) If 9 horses eat 36 bushels of oats in 16 days, what quantity will 20 horses eat in 3 weeks?
- (2) If 3 men earn £6 13s. 4d. in 6 days, what will 15 men earn in 27 days?
- (3) If a family of 6 persons consume 24 pecks of corn in 25 days, how long will 16 pecks last a family of 9 persons?
- (4) If 10 persons spend £150 in 6 months, how many persons will spend £180 in 9 months?
- (5) If 20 men mow 20A. in 16 hours, how many men will mow 15A. in 24 hours?
- (6) If £15 pay 12 men for 30 days, how much will pay 36 men for 20 days?
- (7) If 4 horses plough 13A. in 20 days, in how many days will 8 horses plough 52A.?
- (8) If a man travels 100 miles in 4 days, walking 10 hours a day, how far will he walk in a week, walking 8 hours a day?
- (9) If 4 men can mow 10 acres of wheat in 2 days, how many acres can 6 men mow in 5 days?
- (10) If 5 men can earn 25s. in 2 days, what will 15 men earn in a fortnight?
- (11) If 2 tons are carried 20 miles for £10, how far ought 16 cwt. to be carried for £5?
- (12) If 8 men can earn £20 in 18 days when the days are 12 hours long, how much can 6 men earn in 30 days when the days are 8 hours long?
- (13) If 12 horses plough a field of 12A. in 30 days, how many horses will plough a field of 39A. in 9 days?
- (14) If 6 men earn 15s. in 7 days, how much will 9 men earn in 35 days, the wages of the latter being twice that of the former?
- (15) If 5 men can reap 30A. of oats in 5 days of 14 hours each, how many A. would 7 men reap in 4 days of 10 hours each?
- (16) If 10 men can dig a trench 100 yards long, 4 yards wide, and 3 yards deep in 40 days, in how many days will 5 men dig a trench 45 yards long, 6 yards wide, and 4 yards deep?
- (17) If 56 horses eat 30 bushels of corn in 15 days, how many oxen will eat 50 bushels of corn in 20 days, supposing 3 oxen to eat as much as 5 horses?
- (18) If 60 labourers do a piece of work in 11 days of 9 hours each, how many navvies will do $\frac{2}{3}$ more work in 15 days of 10 hours each, when 2 navvies can do as much as 3 labourers?

(19) If 24 men, in 2 days of 12 hours, can dig a trench 132 yds. long 4 yds. wide, and 2 yds. deep, what length of trench will 90 men dig in 4 days of 9 hours, the trench being 5 yds. wide and 3 yds. deep?

(20) Suppose 180 men can dig a ditch 100 yds. long, 6 ft. wide, and 12 ft. deep, in 6 days, how many men will be able to dig a ditch 80 yds. long, 2 yds. wide, and 4 yds. deep, in 18 days?

(21) If an ordinary train can travel 250 miles in 6 hours, how long will it take an express train to travel 300 miles, supposing the express train to travel $8\frac{1}{2}$ miles more in an hour?

(22) If 20 panes of glass, each 2 ft. long and $1\frac{1}{2}$ ft. wide, cost £1 10s., what will be the price of 36 panes, each measuring $1\frac{1}{2}$ ft. long and $\frac{3}{4}$ ft. wide?

(23) If 190 men can make a road in 15 days, in what time would 570 men make a road 3 times as long as the first?

(24) If 3 men can pick 20 bus. of apples in 2 days, working 10 hours a day, how many men would be required to pick 80 bus. in 3 days working 8 hours a day?

(25) If 2 men can plant 800 geraniums daily, working 8 hours a day, how many geraniums would 3 men plant in 4 days, working 6 hours a day?

(26) If 16 horses plough 30 acres in 40 days of 10 hours each, how many acres will 24 horses plough in 12 days of 9 hours each?

(27) If 108 men earn £166 13s. 4d. in 15 days of 10 hours each, how many men would be able to earn £333 6s. 8d. in 20 days of 12 hours each?

(28) If 40 bars of iron, 10 ft. long, $1\frac{1}{4}$ ft. wide, $\frac{3}{4}$ ft. thick, weigh 10 tons 5 cwt., how much would 20 bars of half the dimensions of the former weigh?

(29) If 40 masons can build a wall 100 ft. long, 5 ft. high, 1 ft. thick, how many masons would be required to build a wall twice as long, 6 ft. high, and $1\frac{1}{2}$ ft. thick?

(30) If a sailing ship can sail 500 knots in 50 hours, how long will it take a steamer to go 600 knots, supposing the steamer to go 5 knots an hour more than the sailing ship?

(31) Suppose 36 men can dig a trench 72 yds. long, 4 yds. wide, and 3 yds. deep; how many men will be required to dig one 80 yds. long, 4 yds. wide, and 6 yds. deep?

(32) If 19 men earn £49 1s. 8d. in 7 days of 8 hours, how much money would 49 men be able to earn in 2 days of 10 hours?

(33) If 7 men dig a trench 80 ft. long, $3\frac{3}{4}$ ft. wide, and 6 ft. deep, in 15 days of $6\frac{1}{2}$ hours each, in how many days of 8 hours will 21 men dig a trench 160 ft. long, $6\frac{3}{4}$ ft. wide, and 4 ft. deep?

(34) If 4 horses plough a field of 20 acres in 2 days $10\frac{2}{3}$ hours, how many acres will 2 horses plough in 5 days of $9\frac{1}{3}$ hours?

(35) If 14 panes of glass each $\frac{3}{4}$ ft. by $\frac{3}{4}$ ft. cost 16s., what number of panes 2 ft. by $2\frac{1}{4}$ ft. can you buy for £2 8s.?

(36) If 500 men earn £7166 13s. 4d. in 200 days of 8 hours, how many hours a day must 600 men work to earn £8600 in 300 days?

(37) Suppose 15 bricklayers use 5000 bricks in building a wall 100 ft. long, 1 ft. broad, and 5 ft. high, how many bricks will they use to build a wall 150 ft. long, 2 ft. broad, and 6 ft. high?

(38) If 5000 flat stones are used to pave a walk 100 ft. long, 1 yd. wide, how many stones should be required to pave a walk 120 ft. long and 5 ft. broad, supposing the stones of the latter to be $\frac{2}{3}$ ft. larger than those of the former?

(39) If 20 copyists can copy 500 pages of a certain book, each leaf containing 30 lines, in 6 days of 8 hours each, how long will it take 24 copyists to copy 600 pages, each containing 24 lines?

(40) If 400 navvies dig a tunnel 330 yds. long, 10 yds. high, 4 yds. wide, in 40 days, working 9 hours a day, how many navvies would dig a tunnel $\frac{1}{2}$ of a mile long, 8 yds. high, and 4 yds. wide, in 100 days of 12 hours?

PRACTICE.

Practice is a ready method of working Rule of Three when the value of a unit only is given.

The following examples have been worked to show the best methods of obtaining results by Practice.

Ex. 1. Find the value of 37, at £4 17s. 6d.

10s.	$\frac{1}{2}$	37	2s. 6d.	$\frac{1}{8}$	37
		4			5
		148			185
5s.	$\frac{1}{2}$	18 10			4 12 6
2s. 6d.	$\frac{1}{2}$	9 5			£180 7 6
		4 12 6			
		£180 7 6			

The result of this and similar examples may be obtained

more readily by making the pounds a whole number, and then subtracting the value of the quantity added.

Ex. 2. Find the value of 77, at £2 13s. 8d.

6s. 8d.	$\frac{1}{3}$	77	or	10s.	$\frac{1}{3}$	77
		2				2
6s. 8d.	$\frac{1}{3}$	154				154
		25 13 4		3s. 4d.	$\frac{1}{3}$	38 10
4d.	$\frac{1}{30}$	25 13 4		4d.	$\frac{1}{30}$	12 16 8
		1 5 8				1 5 8
		<u>£206 12 4</u>				<u>£206 12 4</u>

Ex. 3. Find the value of 49, at 4s. 2½d.

2d.	$\frac{1}{3}$	49	or	3s. 4d.	$\frac{1}{3}$	49
		4				
		196		10d.	$\frac{1}{3}$	8 3 4
½d.	$\frac{1}{6}$	8 2		½d.	$\frac{1}{30}$	2 0 10
		2 0½				2 0½
2,0)		20,6 2½				<u>£10 6 2½</u>
		<u>£10 6 2½</u>				

EXERCISE XLVIII.

- | | |
|--------------------------|-------------------------|
| (1) 17 at £4 2s. 6d. | (2) 37 at £9 15s. 0d. |
| (3) 23 at £3 5s. 0d. | (4) 31 at £12 10s. 0d. |
| (5) 41 at £7 16s. 8d. | (6) 43 at £6 13s. 4d. |
| (7) 73 at £3 10s. 6d. | (8) 47 at £8 12s. 6d. |
| (9) 39 at £2 15s. 5d. | (10) 93 at £4 11s. 8d. |
| (11) 75 at £7 9s. 6d. | (12) 65 at £7 12s. 9d. |
| (13) 59 at £6 8s. 4d. | (14) 86 at £3 6s. 6d. |
| (15) 97 at £12 13s. 8d. | (16) 75 at £10 17s. 6d. |
| (17) 103 at £2 10s. 10d. | (18) 117 at £3 13s. 6d. |
| (19) 76 at £5 13s. 9d. | (20) 83 at £1 7s. 8d. |

EXERCISE XLIX.

- | | |
|------------------------|-----------------------|
| (1) 51 at £7 11s. 3d. | (2) 113 at £7 3s. 7d. |
| (3) 53 at £11 17s. 5d. | (4) 29 at £6 13s. 2d. |
| (5) 57 at £7 6s. 9d. | (6) 79 at £3 3s. 11d. |
| (7) 37 at £2 13s. 7d. | (8) 87 at £9 4s. 8d. |
| (9) 43 at £5 17s. 3d. | (10) 93 at £1 3s. 2d. |

- | | |
|-------------------------|-------------------------|
| (11) 61 at £10 18s. 5d. | (12) 67 at £13 9s. 7d. |
| (13) 119 at £3 9s. 10d. | (14) 131 at £2 17s. 3d. |
| (15) 123 at £6 7s. 10d. | (16) 59 at £3 9s. 3d. |
| (17) 123 at £9 14s. 6d. | (18) 97 at £7 11s. 9d. |
| (19) 73 at £5 16s. 5d. | (20) 137 at £8 12s. 7d. |

EXERCISE L.

- | | |
|--------------------------|---------------------------|
| (1) 23 at £8 12s. 2d. | (2) 65 at £3 9s. 10d. |
| (3) 43 at £6 16s. 7d. | (4) 91 at £2 4s. 9d. |
| (5) 79 at £4 7s. 11d. | (6) 31 at £1 3s. 5d. |
| (7) 59 at £5 17s. 3d. | (8) 87 at £7 8s. 6d. |
| (9) 107 at £15 13s. 2d. | (10) 136 at £2 18s. 3d. |
| (11) 172 at £1 15s. 7d. | (12) 101 at £6 8s. 3d. |
| (13) 207 at £5 7s. 5d. | (14) 362 at £1 9s. 7d. |
| (15) 572 at £4 6s. 2d. | (16) 321 at £3 5s. 9d. |
| (17) 146 at £12 18s. 5d. | (18) 131 at £7 11s. 8d. |
| (19) 297 at £6 19s. 6d. | (20) 761 at £15 14s. 11d. |

EXERCISE LI.

- | | |
|--------------------------|---------------------------|
| (1) 37 at £2 5s. 9½d. | (2) 75 at £7 3s. 2½d. |
| (3) 67 at £4 7s. 6½d. | (4) 29 at £9 11s. 3½d. |
| (5) 59 at £6 13s. 2½d. | (6) 31 at £0 10s. 8¾d. |
| (7) 53 at £0 3s. 9½d. | (8) 71 at £0 1s. 2¾d. |
| (9) 97 at £0 11s. 10¼d. | (10) 23 at £0 7s. 5½d. |
| (11) 89 at £0 9s. 7¼d. | (12) 121 at £0 8s. 3¾d. |
| (13) 265 at £0 2s. 9½d. | (14) 137 at £0 17s. 4¾d. |
| (15) 529 at £0 14s. 6½d. | (16) 468 at £0 16s. 10½d. |
| (17) 627 at £0 13s. 5½d. | (18) 356 at £0 15s. 2¾d. |
| (19) 284 at £0 12s. 7½d. | (20) 739 at £0 18s. 11¾d. |

Ex. 4. Find the value of 3 cwt. 2 qrs. 21 lbs. at £55 10s. 6d. per cwt.

		£	s.	d.
2 qrs.	$\frac{1}{2}$	55	10	6
				3
		166	11	6
14 lbs.	$\frac{1}{4}$	27	16	3
7 lbs.	$\frac{1}{8}$	6	18	$9\frac{3}{4}$
		3	9	$4\frac{7}{8}$
		£204	14	$11\frac{5}{8}$

$$1\frac{3}{4} - \frac{7}{8} \times \frac{1}{2} = \frac{7}{8}$$

By making it 4 cwt. this Ex. may be worked as follows:

£	s.	d.
55	10	6
		4
222	2	0
17	7	0 $\frac{3}{8}$
<u>£204</u>	<u>14</u>	<u>11$\frac{5}{8}$</u>

		£	s.	d.
1 qr.	$\frac{1}{4}$	55	10	6
7 lbs.	$\frac{1}{2}$	13	17	7 $\frac{1}{2}$
		8	9	4 $\frac{1}{8}$
		<u>£17</u>	<u>7</u>	<u>0$\frac{3}{8}$</u>

Ex. 5. Find the value of 14 oz. 8 dwts. 20 grs. of gold at £3 17s. 6d. per oz.

		£	s.	d.
5 dwts.	$\frac{1}{2}$	3	17	6
				2
		7	15	0
				7
		54	5	0
2 $\frac{1}{2}$ dwts.	$\frac{1}{2}$	0	19	4 $\frac{1}{2}$
30 grs.	$\frac{1}{2}$	9	8 $\frac{1}{2}$	
2 grs.	$\frac{1}{16}$	4	10 $\frac{1}{8}$	
				3 $\frac{7}{8}$
		<u>£55</u>	<u>19</u>	<u>2$\frac{3}{4}$</u>

$$13\frac{1}{2} = \frac{105}{8} \times \frac{1}{16} = \frac{7}{8}$$

By adding 11 dwts. 4 grs. this Ex. may be worked as follows:

£	s.	d.
3	17	6
		5
19	7	6
		3
58	2	6
2	3	3 $\frac{1}{2}$
<u>55</u>	<u>19</u>	<u>2$\frac{3}{4}$</u>

		£	s.	d.
10 dwts.	$\frac{1}{2}$	3	17	6
1 dwt.	$\frac{1}{16}$	1	18	9
4 grs.	$\frac{1}{8}$		3	10 $\frac{1}{2}$
				7 $\frac{3}{4}$
		<u>2</u>	<u>3</u>	<u>3$\frac{1}{2}$</u>

EXERCISE LIII.

- (1) 6 cwt. 2 qrs. 21 lbs. 8 oz. at £5 16s. 8d. per cwt.
- (2) 3 tons 2 cwt. 3 rs. 7 lbs. at £60 10s. 8d. per ton.
- (3) 5 tons 5 cwt. 2 qrs. 14 lbs. at £4 11s. 2d. per ton.
- (4) 3 cwt. 1 qr. 7 lbs. 14 oz. at £4 15s. 6d. per cwt.

- (5) 8 cwt. 3 qrs. 11 lbs. 8 oz. at £4 16s. 8d. per cwt.
- (6) 4 tons 14 cwt. 2 qrs. 8 lbs. at £12 10s. 8d. per ton.
- (7) 1 load 1 qr. 6 bus. 2 pks. 1 gal. at £5 16s. 8d. per qr.
- (8) 3 pecks 1 gal. 3 qts. 1 pt. at £4 19s. 6d. per gal.
- (9) 3 qrs. 4 bus. 2 pks. 1 gal. 2 qts. at £6 14s. 6d. per qr.
- (10) 4 lbs. 6 oz. 12 dwts. 16 grs. of gold at £50 6s. 8d. per lb.
- (11) 5 lbs. 3 oz. 15 dwts. 15 grs. of platinum at £1 11s. 6d. per oz.
- (12) 1 lb. 4 oz. 8 dwt. 16 grs. (Troy) at £8 12s. 6d. per lb.
- (13) 2 lbs. 9 oz. 6 drs. 2 scr. (Apoths.) at £9 16s. 8d. per lb.
- (14) 5 lbs. 5 oz. 4 drs. 1 scr. 4 grs. (Apoths.) at £2 1s. 4d. per lb.
- (15) 16A. 3R. 30P. at £2 16s. 4d. per acre.
- (16) 47A. 2R. 28P. at £1 6s. 8d. per acre.
- (17) 5 yds. 1 ft. 8 in. at 16s. 8d. per yd.
- (18) 24 yds. 1 ft. 7 in. at 14s. 8d. per yd.
- (19) 2 qrs. 5 bus. 2 pks. 1 gal. 3 qts. at £4 16s. 8d. per qr.
- (20) 8 yds. 1 ft. 11 in. at £1 4s. 7d. per yd.
- (21) 15 yds. 1 ft. 8 in. at 19s. 5d. per yd.
- (22) 4 lbs. 7 oz. 4 drs. 2 scr. (Apoths.) at £2 17s. 9d. per lb.
- (23) 2 lbs. 3 oz. 5 drs. 1½ scr. (Apoths.) at 7s. 6d. per oz.
- (24) 9 lbs. 11 oz. 7 drs. 1 scr. 4 grs. of quinine at £6 10s. per lb.
- (25) 3 lbs. 7 oz. 16 dwts. (Troy) at £15 13s. 8d. per lb.
- (26) 7 lbs. 6 oz. 18 dwts. 8 grs. (Troy) at £3 17s. 3d. per oz.
- (27) 20A. 2R. 18P. at £43 10s. 8d. per acre.
- (28) 30A. 1R. 8P. at £48 9s. 7d. per acre.
- (29) 4 mo. 3 wks. 1 d. at 16s. 1½d. per week.
- (30) 5 mo. 2 wks. 3 d. at £1 2s. 6d. per week.

MISCELLANEOUS EXAMPLES.

EXERCISE LIII.

- (1) An ensign's pay is 5s. 3d. per day; what will this amount to in a year?
- (2) How many acres will supply 325 oxen with hay, if each ox consumes annually the produce of 1A. 2R. 10P.?
- (3) What is the value of a wedge of gold weighing 20 lbs. 5 oz. 5 dwts. 20 grs. at £5 13s. 4d. per ounce?
- (4) A bankrupt owes £11573 6s. 8d., and he is able to pay 15s. 6½d. in the £; what are his effects worth?
- (5) A gentleman's estates are 3000A. 3R. 30P.; what will be his annual income if the rent averages £1 8s. 4d. per acre?

(6) A person owes £5329 16s. 8d., and he is able to pay 10s. 9d. in the £; what are his effects worth?

(7) A merchant bought 120 tons of cake at 8 guineas per ton, by the sale of which he intended to gain £252; what would have been the price per ton and his gain per cent.? A portion getting damaged, he was obliged to sell the whole at £9 10s. per ton; what was his gain, and gain per cent.?

(8) A man receives £1 3s. 4d. per week of 6 days, what will he receive for 210 days' work?

(9) A bankrupt owes £9632 6s. 3d. and he is able to pay 11s. 8d. in the £; what are his effects worth?

(10) If a gentleman's estate be worth £5396 10s. 5d., and the land tax is assessed at 3s. 6d. in the £, what is his annual income?

(11) A farmer hires 642A. 2R. 24P. at 27s. 6d. per acre, and sublets 230A. 3R. 10P. at an increase of rental of 4s. 6d. per acre; what will he receive, what will be his gain on the portion sublet, and, taking his gain into consideration, what will his farm cost him?

(12) A merchant buys 80 tons 15 cwt. 2 qrs. of coal at 18s. 4d. per ton, and retails the same at £1 1s. 8d. per ton; what will they cost him, and what will be his entire gain?

(13) A gentleman's annual income is £3500, he pays an income tax of 4d. in the £, and his other rates and taxes amount to 3s. 9d. in the £; what is his net annual income, and supposing him to spend £2300 a year, what will he save in 10 years?

(14) A druggist buys 3 lbs. 4 oz. 5 drs. of quinine at 12s. 9d. per oz.; he sells 1 lb. 8 oz. 6 drs. 16 grs. in 3 months at 2s. 6d. per dram, how much more will he require to sell to liquidate his debt, and what will be his entire gain, and gain per cent. by selling all at that price?

(15) A town is assessed at £15326, what will the poor rate amount to at 1s. 9 $\frac{3}{4}$ d. in the £, a church rate at 2 $\frac{1}{2}$ d. and the paving and lighting at 7 $\frac{1}{4}$ d., and what would be the amount of taxes paid by a person rated at £63 10s.?

(16) What will be the profit arising from a garden containing 1A. 1R. 17P., which is planted with 40 bus. of potatoes at 2s. 3d. per bushel, the cost of planting being 4d. per bushel, and the produce ten times the amount of seed which was sold at 2s. 9d. per bushel, the cost of digging being $\frac{3}{4}$ d. per bushel; rent £6 10s. an acre, cost of manure 36s. an acre, and cost of digging preparatory to planting 3 $\frac{1}{2}$ d. per pole?

(17) What will be the loss on a debt of £1856 11s. 8d. if a bankrupt's effects pay 5s. 4 $\frac{1}{2}$ d. in the £?

(18) A farmer consumes during harvest 17 barls. 27 gals. 3 qts. 1 pt. of beer; what does it cost him at £1 11s. 6d. per barrel?

(19) A wine merchant mixed 1 pipe of sherry 108 gals. at 14s. 6d. a gal., with a pipe at 12s. 6d. a gal., to which was added 20 gals. of brandy at 21s. 6d. a gal., what would he gain by selling it at 36s. a doz. (2 gals. = 1 doz.), and at what price must he sell it per doz. to gain £51?

(20) What is the value of a wedge of pure gold weighing 3 lbs. 8 oz. 6 dwts. 16 grs., when standard gold is worth £3 17s. 10½d. per oz. (neglecting the value of alloy), pure gold is to standard gold as 12 : 11?

(21) A grocer bought 15 cwt. 3 qrs. 18 lbs. of sugar at £2 7s. 6d. per cwt., 12 cwt. 2 qrs. 11 lbs. of butter at £4 13s. 4d. per cwt., and 2 cwt. 3 qrs. 20 lbs. of rasins at £1 12s. 6d. per cwt.; what was the amount of this bill.

(22) A farmer grows 57A. 3R. 25P. of wheat which averages 3 qrs. 7 bus. 2 pks. 1 gal. per acre of prime wheat at 47s. 6d. per quarter, the tail wheat averages 3 bus. 2½ pks. at 23s. 6d. per quarter, required value of the whole.

(23) A grocer buys 5 hds. of sugar each weighing 3 cwt. 1 qr. 3 lbs. at £1 12s. 8d. per cwt. (weight of each hd. 47 lbs.). What will it cost him, and what will be his gain by selling it at 4½d. per pound?

(24) If 48764538 lbs. of tobacco are imported into this country annually and the average duty is 5s. 9¾d. per lb., what is the amount paid to the revenue?

INTEREST.

Interest is money paid for the use of other money which is called the **Principal**.

Rate per cent. is the sum paid for the use of £100, as 3, 4, 5 per cent., &c.

Amount is the sum produced by the addition of the principal and interest, e.g. the interest of £100 for a year at 5 per cent. would be £5, and the amount would be £100 + £5 = £105.

Let I = interest, P = principal, M = amount.

∴ M = P + I. Let n = number of years or time. Let r = rate per cent. or interest on £100. ∴ the interest of £1 = $\frac{r}{100}$ and the interest on £P, or the principal = $\frac{Pr}{100}$; this would be for one year, ∴ for two years it would be twice as much, for three years three times as much, and for n years

n times as much, \therefore the interest of $\text{£}P$ for n years would be $\frac{Prn}{100}$, consequently we should have $I = \frac{Prn}{100}$, and as $M = P + I$, $\therefore M = P + \frac{Prn}{100}$. From these formulæ, we derive the ordinary rules for interest.

RULE.—To find the interest of any sum of money, multiply the principal by the rate per cent. and by the number of years, and divide by 100. If the amount is required add the principal to the interest.

After a little practice it will be found easier to work by the formulæ, as you can find either I , P , r , n , or M , whichever may be required. The same formulæ can also be used for discount and present worth, which will be explained hereafter.

Ex. 1. Required the interest on $\text{£}500$ for 4 years at 5 per cent.

$$I = \frac{Prn}{100}$$

$$\therefore I = \frac{500 \times 5 \times 4}{100} = \text{£}100.$$

These examples can all be worked without the formulæ.

$\begin{array}{r} \text{£}500 \\ 4 \\ \hline 2000 \\ 5 \\ \hline 1,00)100,00 \\ \hline \text{£}100 \end{array}$	To divide by 100 simply cut off two figures to the right of both dividend and divisor.
---	--

Ex. 2. What principal must be put out to interest for 4 years at 5 per cent. to produce $\text{£}100$ interest? Here P is required, therefore we shall have

$$\frac{Prn}{100} = I$$

$$\frac{P \times 5 \times 4}{100} = 100$$

$$\therefore \frac{P}{5} = 100 \quad \therefore P = \text{£}500.$$

It is evident that £100 put out to interest for 4 years at 5 per cent. would produce £20. Required to find what principal must be put out for 4 years at 5 per cent. to produce £100. By proportion we have: if £100 produce £20 what will produce £100?

$$\begin{array}{ccc} 20 & : & 100 :: 100 \\ & 5 & 5 \\ & \hline & & £500 \end{array}$$

Ex. 3. How long must £500 be put to interest at 5 per cent. to produce £100 interest? Again we have

$$\begin{array}{l} \frac{Prn}{100} = I \\ \begin{array}{c} 5 \\ 500 \times 5 \times n \\ \hline 100 \end{array} = 100 \\ \therefore 25n = 100 \\ \therefore n = 4. \end{array}$$

£500 put out to interest at 5 per cent. for 1 year would produce £25. How long will it take to produce £100?

$$\begin{array}{ccc} 25 & : & 100 : 1 \text{ year} \\ & & 4 \text{ yrs.} \end{array}$$

Ex. 4. At what rate of interest must £500 be put out to produce £100 in 4 years?

$$\begin{array}{l} \frac{Prn}{100} = I \\ \begin{array}{c} 5 \\ 500 \times 4 \times r \\ \hline 100 \end{array} = 100 \\ 20r = 100 \\ r = 5. \end{array}$$

£500 at 1 per cent. for 4 years would produce £20; at what rate per cent. must it be put out to gain £100?

$$\begin{array}{ccc} 20 & : & 100 :: 1 \text{ per cent.} \\ & & 5 \text{ per cent.} \end{array}$$

Ex. 5. Find the interest on £1248 12s. at $3\frac{1}{2}$ per cent. for 3 years.

$$£1248 \text{ 12s.} = £1248\frac{3}{4} = £\frac{6243}{5} \text{ and } 3\frac{1}{2} = \frac{7}{2}.$$

$$I = \frac{Prn}{100}$$

$$I = \frac{6243 \times 25 \times 3}{5 \times 100 \times 2} = £\frac{18729}{160} = £117 \text{ 1s. } 1\frac{1}{2}d.$$

Find the interest on £1248 12s. at $3\frac{1}{2}$ per cent. for 3 years.

$$\begin{array}{r}
 \begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 1248 \quad 12 \quad 0 \\
 \hline
 3\frac{1}{2} \\
 \hline
 3745 \quad 16 \quad 0 \\
 156 \quad 1 \quad 6 \\
 \hline
 3901 \quad 17 \quad 6 \\
 3 \\
 \hline
 117 \cdot 05 \quad 12 \quad 6 \\
 20 \\
 \hline
 1 \cdot 12 \\
 12 \\
 \hline
 1 \cdot 50 = \frac{1}{2}
 \end{array}
 \end{array}$$

Ans. £117 1s. $1\frac{1}{2}$ d.

Ex. 6. Find the interest on £170 6s. 8d. from April 16, 1859, to Nov. 7, 1862 (not including both days) at $4\frac{1}{2}$ per cent.

$$\text{£170 6s. 8d.} = \text{£}170\frac{1}{2} = \text{£}211.$$

$$4\frac{1}{2} \text{ per cent.} = \frac{9}{2}.$$

$$\text{Time} = 3 \text{ yrs. } 205 \text{ dys.} = 3\frac{1}{3} = \frac{10}{3}.$$

$$I = \frac{Prn}{100}$$

$$I = \frac{211 \times 205 \times \frac{9}{2}}{100 \times \frac{10}{3} \times \frac{1}{2}} = \text{£}27\frac{1}{10} = \text{£}27 \text{ 6s.}$$

Find the interest on £170 6s. 8d. from April 16, 1859, to Nov. 7, 1862 (not including both days), at $4\frac{1}{2}$ per cent.

$$\text{Time} = 3 \text{ yrs. } 205 \text{ days.}$$

$$\begin{array}{r}
 \begin{array}{r}
 \text{By the Rule} \quad \begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 170 \quad 6 \quad 8 \\
 \hline
 4\frac{1}{2} \\
 \hline
 681 \quad 6 \quad 8 \\
 85 \quad 3 \quad 4 \\
 \hline
 7 \cdot 66 \quad 10 \quad 0 \\
 20 \\
 \hline
 13 \cdot 30 \\
 12 \\
 \hline
 3 \cdot 6 = 3\frac{3}{5}
 \end{array}
 \end{array}
 \end{array}$$

∴ Interest for 1 year =

$$\begin{array}{r}
 \text{£} \quad \text{s.} \quad \text{d.} \\
 7 \quad 13 \quad 3\frac{3}{5} \\
 \hline
 3
 \end{array}$$

$$\text{£}22 \ 19 \ 10\frac{1}{5} =$$

Interest for 3 years.

INTEREST.

$$\begin{array}{r}
 \begin{array}{ccccc}
 & & \text{\textit{d.}} & & \\
 \text{\textit{q.}} & : & \text{\textit{q.}} & :: & \\
 73 & & 41 & & \\
 & & 20 & & \\
 & & \hline
 & & 153 & & \\
 & & 12 & & \\
 & & \hline
 & & 1839 & & \\
 & & 5 & & \\
 & & \hline
 & & 9198 & & \\
 & & \hline
 & & 5 & &
 \end{array}
 \end{array}$$

$$\frac{126}{5} \times \frac{41}{1} \times \frac{1}{73} = \frac{5166}{5} d. = 1033\frac{1}{5} d. =$$

£ £ d.

4 6 $1\frac{1}{2}$ = interest for 205 days

$$22\ 19\ 10\frac{4}{5} = \text{interest for 3 years}$$

£27 6 0 = interest for 3 years and 205 days.

Ex. 7. What principal put out to interest for 3 years at 4 per cent. would amount to £184 7s. 7½d.?

Substituting the values for M, r, and n, in the following equation, we have

$$P + \frac{Prn}{100} = M$$

$$£184 \text{ 7s. } 7\frac{1}{2}d. = \frac{9219}{60} = M; P + \frac{P \times \frac{1}{4} \times 3}{\frac{100}{25}} = \frac{9219}{60}$$

$$P + \frac{3P}{25} = \frac{9219}{50}$$

$$50 P + 6 P = 9219$$

56 P=9219

$\therefore P = \text{£}164\ 12s.\ 6d.$

Without the formulæ we first find the amount of £100 for 3 years at 4 per cent. = £112.

Then, by proportion, if £100 will amount to £112 in 3 years at 4 per cent., what sum will amount to £184 7s. 7½d.?

As £112 : £184 7s. 7½d. :: £100

$$\begin{array}{r} 20 \\ 3687 \\ 12 \\ \hline 44251 \\ 5 \\ \hline 221256 \\ 5 \\ \hline 3951 \quad 10 \\ 31808 \quad 20 \\ \hline \therefore \frac{1}{112} \times \frac{221256}{5} \times \frac{100}{1} = 39510d. = £164 \text{ 12s. } 6d. \end{array}$$

Prove that if £164 12s. 6d. be put out to interest for 3 years at 4 per cent. it will amount to £184 7s. 7½d.

$$£164 \text{ 12s. } 6d. = £164\frac{5}{8} = £131\frac{17}{8}.$$

$$I = \frac{Prn}{100}$$

$$I = \frac{1317 \times \frac{1}{4} \times 3}{100 \times \frac{8}{2}} = \frac{£2951}{200} = \begin{array}{r} £ \quad s. \quad d. \\ 19 \quad 15 \quad 1\frac{1}{2} \\ 164 \quad 12 \quad 6 \\ \hline £184 \quad 7 \quad 7\frac{1}{2} \end{array}$$

$$\begin{array}{r} £ \quad s. \quad d. \\ 164 \quad 12 \quad 6 \\ \hline 4 \\ 658 \quad 10 \quad 0 \\ \hline 3 \\ £19 \cdot 75 \quad 10 \quad 0 \\ 20 \\ \hline 15 \cdot 10 \\ 12 \\ \hline 1 \cdot 2 = 1\frac{1}{2}. \end{array}$$

Interest for 3 yrs. at 4 per cent.

$$\begin{array}{r} £ \quad s. \quad d. \\ 19 \quad 15 \quad 1\frac{1}{2} \\ 164 \quad 12 \quad 6 \\ \hline \end{array}$$

$$£184 \quad 7 \quad 7\frac{1}{2} = \text{amount.}$$

When months and days are both given you must consider each as the fraction of a year.

E.g. 5 yrs. 3 mo. 190 dys.

$$3 \text{ mo.} = \frac{1}{4} \text{ yr.} \quad 190 \text{ dys.} = \frac{190}{365} = \frac{38}{73}.$$

$$\therefore \frac{1}{4} + \frac{38}{73} = \frac{73 + 152}{292} = \frac{225}{292} = 5 \text{ yrs.} = 5\frac{225}{292} \text{ yrs.}$$

When the time is given from one date to another, you must calculate

how many years and how many days (not including both mentioned), and put the days in the form of the fraction of a year.

Find the interest on £344 18s. 4d. from March 1st to December 1st at 4 per cent.

£261 11s. 8d. = £261 $\frac{7}{12}$ = £213 $\frac{29}{12}$. March 1st to December 1st = 275 days = $\frac{275}{365}$ = $\frac{55}{73}$.

$$I = \frac{Prn}{100}$$

$$I = \frac{43}{100} \times \frac{11}{20} \times \frac{55}{73} \times \frac{4}{100} = \frac{473}{80} = £7 17s. 8d.$$

It is quite evident from these examples, worked both by formulæ and rule, that the formulæ has the decided preference whenever the examples are either long or complicated. Moreover, I have found by experience that boys easily learn the formulæ, and prefer it to the ordinary rules.

EXERCISE LIV.

- (1) Find the simple interest and amount on £300 for 4 years at 5 per cent.
- (2) Find the simple interest and amount on £700 for 3 years at 4 per cent.
- (3) Find the simple interest and amount on £420 for $3\frac{1}{2}$ years at 3 per cent.
- (4) Find the simple interest and amount on £640 for 9 years at $4\frac{1}{4}$ per cent.
- (5) Find the simple interest and amount on £1256 for 7 years at $3\frac{1}{2}$ per cent.
- (6) Find the simple interest and amount on £1845 for $6\frac{1}{2}$ years at $4\frac{1}{4}$ per cent.
- (7) Find the simple interest and amount on £1420 10s. 6d. for 4 years at 5 per cent.
- (8) Find the simple interest and amount on £291 13s. 4d. for 6 years at $3\frac{3}{4}$ per cent.
- (9) Find the simple interest and amount on £588 6s. 8d. for 5 years at $3\frac{1}{2}$ per cent.

(10) Find the simple interest and amount on £1050 12s. 6d. for $5\frac{1}{2}$ years at $4\frac{1}{2}$ per cent.

(11) Find the simple interest and amount on £32 5s. 8d. for 7 years at $4\frac{1}{2}$ per cent.

(12) Find the simple interest and amount on £691 4s. 0d. for $5\frac{3}{4}$ years at $3\frac{3}{4}$ per cent.

(13) Find the simple interest and amount on £367 10s. 0d. for $4\frac{1}{2}$ years at $3\frac{3}{4}$ per cent.

(14) Find the simple interest and amount on £737 12s. 6d. for 9 months at $4\frac{1}{2}$ per cent.

(15) Find the simple interest and amount on £219 for 117 days at $4\frac{3}{4}$ per cent.

(16) Find the simple interest and amount on £346 15s. 0d. for 3 years 215 days at $4\frac{1}{2}$ per cent.

(17) Find the simple interest and amount on £150 10s. 0d. for 2 years 8 mo. 25 dys. at 5 per cent.

(18) Find the simple interest and amount on £3114 13s. 4d. for 5 years 9 months 40 days at $3\frac{1}{2}$ per cent.

(19) Find the simple interest and amount on £2133 6s. 8d. for 3 years 6 months 73 days at $4\frac{1}{4}$ per cent.

(20) Find the simple interest and amount on £1450 17s. 6d. for 6 years 4 months 145 days at 5 per cent.

EXERCISE LV.

(1) Find the simple interest on £300 from January 10th to November 3rd at $4\frac{1}{2}$ per cent.

(2) Find the interest on £243 6s. 8d. from May 15th to November 7th at $3\frac{3}{4}$ per cent.

(3) Find the amount on £1231 17s. 6d. from March 1st 1840 to June 11th 1842 at $3\frac{1}{4}$ per cent.

(4) How long must £535 be put out to interest at $3\frac{3}{4}$ per cent. to produce £80 5s. 0d.?

(5) Find the amount on £1703 6s. 8d. from July 1st 1859 to June 26th 1861 at $4\frac{1}{2}$ per cent.

(6) At what rate per cent. must £537 16s. 8d. be invested for 4 years to produce £53 15s. 8d. interest?

(7) How long must £345 17s. 6d. be put out to interest at 4 per cent. to amount to £387 7s. 7½d.?

(8) What principal will produce £618 interest in 9 years 315 days at 5 per cent.?

(9) At what rate per cent. will £1303 6s. 8d. amount to £1884 18s. 11d. in 7 years?

(10) In what time will £527 10s. 0d. amount to £602 13s. 4½d. at 3¾ per cent.?

(11) How long will it take £446 10s. 0d. to amount to £519 1s. 1½d. at 5 per cent.?

(12) At what rate per cent. must £540 be put out to interest to amount to £734 8s. 0d. in 9 years?

(13) What principal will produce £77 2s. 11¼d. interest in 4½ years at 3¼ per cent.?

(14) How long will it take £1043 15s. 0d. to amount to £1165 10s. 5d. at 5¾ per cent.?

(15) What principal will amount to £845 10s. in 2½ years at 4½ per cent.?

(16) How long must £1825 be put out to interest at 3½ per cent. to produce £11 4s.?

(17) At what rate per cent. must £1391 13s. 4d. be put out to interest to amount to £1416 14s. 4d. in 146 days?

(18) In what time will £2128 amount to £2167 18s. 0d. at 3¾ per cent.?

(19) At what rate per cent. must £3292 be put out to interest to amount to £3549 3s. 9d. in 2½ years?

(20) What principal will amount to £1834 10s. 9d. in 3½ years at 3¾ per cent.?

(21) In what time will £18922 13s. 4d. amount to £20814 18s. 8d. at 3½ per cent.?

(22) At what rate per cent. must £11535 be put out to interest to amount to £13842 in 4 years?

(23) What principal will amount to £16416 in 1 year 10 days at 4 per cent.?

(24) At what rate per cent. must £5718 6s. 8d. be put out to interest to amount to £6031 13s. 4d. in 1 year 135 days?

(25) How long will it take £15642 0s. 0d. to amount to £20334 12s. 0d. at 5 per cent.?

(26) Find the simple interest on £3234 16s. 3d. from January 11th to March 16th 1864 at 5 per cent.

(27) At what rate per cent. must £4471 5s. be put out to interest to amount to £4792 4s. in 2 years 56 days?

(28) At what rate per cent. must £2737 10s. be put out to interest to amount to £3285 in 5 years?

(29) Find the simple interest on £821 5s. for 3 years 4 months 21 days at 3¼ per cent.

(30) What principal will amount to £43590 12s. 6d. in 1 year 10 days at 3½ per cent.?

PRESENT WORTH AND TRUE DISCOUNT.

Present Worth is that sum of money which, if put out to interest at a given rate per cent. for a given time, will amount to a given sum.

The present worth of £100 due a year hence at 5 per cent. is £95 4s. 9½d. Consequently £95 4s. 9½d. put out to interest at 5 per cent for 1 year would amount to £100. The difference between (the sum of money) £100, and (the present worth) £95 4s. 9½d. is £4 15s. 2½d. = the **True Discount**.

Commercial Discount is the simple interest for the given time on the amount due, e.g. the commercial discount of £100 due one year hence at 5 per cent. is £5.

From the above it is evident that, to find the **Present Worth** of a sum of money, we must find what principal put out to interest at a given rate for a given time will amount to the given sum. In fact, it is simply the application of the formulæ

$$P + \frac{Prn}{100} = M,$$

which has already been applied to the solution of Example 7.

Required the present worth of £370 4s. 8½d. due 15 months hence at 4½ per cent. simple interest.

$$£370 \text{ 4s. } 8\frac{1}{2}d. = 370\frac{15}{84} = \frac{23695}{84};$$

$$\text{time} = \frac{15}{12} = \frac{5}{4}; \text{ rate per cent.} = 4\frac{1}{2} = \frac{9}{2}.$$

$$P + \frac{Prn}{100} = M$$

$$P + \frac{P \times \frac{5}{4} \times \frac{9}{2}}{\frac{100 \times 4 \times 8}{20}} = \frac{23695}{84}$$

$$P + \frac{37P}{640} = \frac{23695}{84}$$

$$640 P + 37 P = 236950$$

$$677 P = 236950$$

$$P = £350 \text{ present worth.}$$

$$£370 \text{ 4s. } 8\frac{1}{2}d. - £350 = £20 \text{ 4s. } 8\frac{1}{2}d. = \text{true discount.}$$

To work this example by the rule, it will be exactly similar to Example 7. We must find the amount of £100 for 15 months at $4\frac{5}{8}$ per cent.

$$\begin{array}{r}
 £100 \\
 \underline{4\frac{5}{8}} \\
 400 \\
 62\frac{1}{2} \\
 \underline{462\frac{1}{2}} \\
 2 \\
 \hline
 \frac{925}{2} \times \frac{5}{4} = \frac{4625}{8} = 578 \frac{2}{8} \frac{6}{8} \\
 \frac{20}{15.62} \\
 \frac{12}{7.50}
 \end{array}$$

∴ interest = £5 15s. $7\frac{1}{2}d.$

∴ the amount of £100 for 15 months at $4\frac{5}{8}$ per cent. = £105 15s. $7\frac{1}{2}d.$

By Proportion we have: if £100 amounts to £105 15s. $7\frac{1}{2}d.$ in 15 months at $4\frac{5}{8}$ per cent., what sum will amount to £370 4s. $8\frac{1}{2}d.$?

£	s.	d.	:	£	s.	d.	::	£
105	15	$7\frac{1}{2}$		370	4	$8\frac{1}{2}$		100
<u>20</u>				<u>20</u>				2
2115				7404				
<u>12</u>				<u>12</u>				
25387				88856				
<u>4</u>				<u>4</u>				
101550				355125				
2031				118475				
677				2				

677) 236950 (£350 = present worth.

2031

3385

3385

0

£370 4s. $8\frac{1}{2}d.$ - £350 = £20 4s. $8\frac{1}{2}d.$ = true discount.

EXERCISE LVI.

Find the present worth and true discount of the following amounts:—

- (1) £735 9s. 6d. due 10 months hence at 4 per cent.
- (2) £736 15s. 0d. due 1 yr. 3 mo. hence at 4 per cent.
- (3) £864 11s. 8d. due 9 months hence at 5 per cent.
- (4) £913 17s. 6d. due $2\frac{1}{2}$ years hence at 5 per cent.
- (5) £1885 16s. 2d. due $3\frac{3}{4}$ years hence at 4 per cent.
- (6) £15239 2s. 11d. due $1\frac{1}{4}$ years hence at 3 per cent.
- (7) £9730 7s. 4d. due 1 yr. 73 dys. hence at $3\frac{1}{8}$ per cent.
- (8) £3879 8s. 0d. due 2 yrs. 20 dys. hence at £3 0s. 10d. per cent.
- (9) £6670 6s. 0d. due 1 yr. 135 dys. hence at £3 13s. 0d. per cent.
- (10) £9974 5s. 1d. due 1 yr. 8 mo. hence at £3 15s. 0d. per cent.
- (11) £204 1s. 11d. due 4 months hence at 5 per cent.
- (12) £351 11s. 10d. due 1 yr. 35 dys. hence at £3 0s. 10d. per cent.
- (13) £615 11s. 9d. due 3 mo. hence at $3\frac{1}{8}$ per cent.
- (14) £673 5s. 1d. due 250 days hence at £3 13s. per cent.
- (15) £145071 8s. 9d. due 125 days hence at £2 8s. 8d. per cent.

Find the present worth and true discount of the following bills:—

- (16) £73 4s. 0d. drawn January 6th at 4 months, discounted April 14th at 4 per cent.
- (17) £146 12s. 0d. drawn July 20th at 3 months, discounted September 23rd at 5 per cent.
- (18) £176 15s. 0d. drawn March 10th at 7 months, discounted August 1st at 5 per cent.
- (19) £1099 10s. 0d. drawn June 23rd at 4 months, discounted September 11th at $3\frac{1}{8}$ per cent.
- (20) £292 16s. 0d. drawn April 4th at 2 months, discounted May 13th at 4 per cent.
- (21) £440 8s. 0d. drawn September 3rd at 3 months, discounted October 27th at 5 per cent.
- (22) £2052 15s. 0d. drawn April 20th at 8 months, discounted November 3rd at $3\frac{1}{8}$ per cent.
- (23) £585 4s. 0d. drawn July 5th at 4 months, discounted October 19th at $3\frac{1}{8}$ per cent.
- (24) £1684 15s. 0d. drawn August 23rd at 3 months, discounted October 22nd at $3\frac{1}{8}$ per cent.
- (25) £1538 12s. 0d. drawn September 25th at 2 months, discounted October 19th at $3\frac{1}{8}$ per cent.

104 EXERCISES IN PRESENT WORTH AND TRUE DISCOUNT.

(26) £120 5s. 0d. drawn March 25th at 8 months, discounted August 20th at 5 per cent.

(27) £229 1s. 3d. drawn May 20th at 3 months, discounted July 9th at $3\frac{1}{2}$ per cent.

(28) £268 4s. 4d. drawn March 3rd at 2 months, discounted April 21st at 5 per cent.

(29) £671 14s. 8d. drawn July 18th at 4 months, discounted October 17th at 4 per cent.

(30) £383 15s. 6d. drawn September 2nd at 2 months, discounted October 20th at $3\frac{1}{2}$ per cent.

(31) £4112 10s. 0d. drawn February 23rd at 7 months, discounted July 15th at $3\frac{1}{2}$ per cent.

(32) £611 1s. 8d. drawn May 17th at 4 months, discounted July 27th at 3 per cent.

(33) £715 0s. 0d. drawn October 3rd at 2 months, discounted November 11th at $2\frac{1}{2}$ per cent.

(34) £4910 13s. 4d. drawn June 21st at 6 months, discounted October 19th at 5 per cent.

(35) £3919 0s. 0d. drawn January 7th at 8 months, discounted June 25th at $3\frac{1}{2}$ per cent.

COMMERCIAL DISCOUNT.

EXERCISE LVII.

Find the commercial discount on the following bills:—

(1) £326 13s. 6d. drawn February 2nd at 2 months, discounted March 11th at 5 per cent.

(2) £1812 16s. 8d. drawn June 9th at 2 months, discounted July 3rd at 5 per cent.

(3) £342 3s. 9d. drawn May 2nd at 90 days, discounted July 6th at $5\frac{1}{2}$ per cent.

(4) £2402 18s. 4d. drawn February 6th at 12 months, discounted June 14th at $4\frac{1}{2}$ per cent.

(5) £14089 0s. 0d. drawn September 4th at 4 months, discounted November 28th at 5 per cent.

(6) £6478 15s. 0d. drawn April 1st at 6 months, discounted July 1st at $3\frac{3}{4}$ per cent.

(7) £5318 15s. 0d. drawn July 23rd at 6 months, discounted September 2nd at 4 per cent.

(8) £5864 6s. 8d. drawn April 4th at 60 days, discounted April 22nd at 5 per cent.

(9) £2479 3s. 4d. drawn March 23rd at 6 months, discounted July 15th at $3\frac{1}{2}$ per cent.

(10) £4866 13s. 4d. drawn May 18th at 7 months, discounted October 7th at $3\frac{1}{2}$ per cent.

(11) £28129 6s. 8d. drawn July 3rd at 2 months, discounted August 12th at 5 per cent.

(12) £13079 3s. 4d. drawn June 13th at 5 months, discounted September 27th at 4 per cent.

The following are the forms for a negotiable bill and promissory note.

NEGOTIABLE BILL.

£326 13s. 6d.

Hoddesdon, May 2nd, 1866.

Two months after date pay to my order three hundred and twenty-six pounds thirteen shillings and sixpence for value received.

To Mr. John Smith.

THOS. BROWN.

Payable at Messrs. Lubbock and Co., London.

PROMISSORY NOTE.

£326 13s. 6d.

Hoddesdon, May 2nd, 1866.

Two months after date I promise to pay to Mr. Thos. Brown or order three hundred and twenty-six pounds thirteen shillings and sixpence, for value received.

JOHN SMITH.

Payable at Messrs. Lubbock and Co., London.

INSURANCE, COMMISSION, AND BROKERAGE.

Policies of Insurance are granted by the different offices both on lives and property. In the former instance the premium depends on the age and health of the person to be insured; in the latter instance on the risk incurred.

Insurances are very fully explained in the pamphlets given away by the various offices.

Required the yearly premium to be paid on a life of 30 for £500. If the life be healthy the premium would be about £2 4s. 3d. per cent. ∴ for £500 it would be £2 4s. 3d. $\times 5 =$ £11 1s. 3d.

Required the yearly premium to be paid on property valued at £700 against the risk of fire at 5s. 6d. per cent.

$$\text{Premium} = 5s. 6d. \times 7 = \text{£}1 \text{ } 18s. 6d.$$

For what must goods worth £1900 be insured at 5 per cent. so that, in case of loss, the value of both goods and premium may be recovered?

In this instance £100 must be insured to realise £95, as £5 has been paid for premium.

$$\begin{array}{rcl} 95 & : & 1900 \quad :: \quad 100 \\ 100 & 20 & \\ \hline \frac{1900 \times 100}{95} & = & \text{£}2000. \end{array}$$

Commission is percentage paid to an agent for buying or selling goods, and is merely the simple interest for 1 year at a certain rate per cent. on the transaction.

Brokerage is a small percentage on money transactions, and principally refers to buying and selling stocks, and does not generally exceed a few shillings per cent. The usual fee for buying or selling stock is 2s. 6d., or $\frac{1}{2}$ per cent.

INSURANCE, COMMISSION, AND BROKERAGE.

EXERCISE LVIII.

(1) I have goods of the value of £47500, which I wish to insure at 5 per cent., so that in case of loss I may recover both the value of insurance and premium.

(2) For what sum should a ship worth £4347 be insured at $6\frac{1}{2}$ per cent., so that in case of loss the owner may recover both value of cargo and premium?

(3) What will be the cost of insuring a house whose value is £2880 at 4s. 6d. per cent.?

(4) What is the premium on a policy of insurance for £1428 16s. 0d.

upon the life of a person whose age is 35, at the rate of £3 2s. 6d. for that age ?

(5) For what sum should goods worth £11381 13s. 3d. be insured at £3 16s. 0d. per cent., so that in case of loss the owner may recover the value of both goods and premium ?

(6) What is the premium on a policy of insurance for £4000 upon the life of a person aged 45, at £3 15s. 0d. per cent. for that age ?

(7) For what amount should property be insured worth £770 at 3 $\frac{3}{4}$ per cent. so that in case of its being burnt, the owner may recover the value of it together with the premium paid ?

(8) For what sum should a ship worth £1132 16s. 0d. be insured at 4 per cent. so that the owner in case of loss may recover both the value of cargo and premium ?

(9) A person has goods of the value of £12236 5s. 0d., which he wishes to insure at 2 $\frac{1}{2}$ per cent. so that in case of loss he may recover the value of both goods and premium.

(10) What is the brokerage upon £1609 7s. 6d. at 2s. 6d. per cent. ?

(11) For what amount should a ship worth £5539 be insured at 4 $\frac{1}{2}$ per cent. so that the owners, in case of loss, may recover the value of the ship and premium ?

(12) What is the commission upon £25620 at 3 $\frac{1}{4}$ per cent. ?

(13) For what sum should stores be insured worth £385 1s. 11d. at £3 6s. 8d. per cent., so that in case of fire the owner may recover the value of both his stores and premium ?

(14) What is the brokerage upon £366 13s. 4d. at 3s. 4d. per cent. ?

(15) For what sum of money should a wheat stack be insured worth £179 13s. 4d. at 3 $\frac{3}{4}$ per cent., so that the farmer may recover, in case of loss, the value of both stack and premium ?

(16) What is the commission of £533 6s. 8d. at 1 $\frac{1}{2}$ per cent. ?

(17) At what amount must I insure a house worth £1673 14s. 0d. at 7s. 6d. per cent. so that in case of fire I may recover both the value of house and premium ?

(18) What is the premium on a policy of insurance upon £4560 at 3 $\frac{3}{4}$ per cent. ?

(19) For what sum of money should a person insure goods worth £403 12s. 11d. at £3 2s. 6d. per cent., so that he may, in case of loss, be able to recover the value of both goods and premium ?

(20) For what sum must a farmer insure his farm premises which are worth £3790 10s. 0d. at 5s. per cent. so that in case of fire he may be able to recover both the value of the farm premises and premium ?

(21) What is the premium on a policy of insurance of £2500 for a person aged 20 at £1 13s. 6d. per cent. ?

(22) What would be the expense of insuring goods worth £8211 at $2\frac{1}{4}$ per cent. so that in case of loss the owner may recover the value of goods and premium; and what would be the cost of insurance?

(23) What is the brokerage upon £1787 10s. 0d. at 2s. 6d. per cent.?

(24) A person aged 30 wishes to insure his life for £2500; what will he have to pay yearly at £1 6s. 8d. per cent.?

(25) What is the commission upon £583 17s. 4d. at £3 2s. 6d. per cent.?

(26) What will be the cost of transferring stock worth £10856 13s. 4d. at $\frac{1}{8}$ per cent.?

(27) For what sum must a cargo worth £481 5s. 0d. be insured at $3\frac{3}{4}$ per cent., so that the owner, in case of loss, may recover both the value of cargo and premium?

(28) A person aged 30 wishes to insure his life for £1200; what will he have to pay yearly at £2 10s. 0d. per cent.?

(29) What is the commission upon £17986 8s. 0d. at $4\frac{1}{8}$ per cent.?

(30) For what sum must goods worth £48628 3s. 4d. be insured at $3\frac{1}{2}$ per cent. so that in case of loss the owner may recover the value of goods and premium; and what would be the cost of insurance?

COMPOUND INTEREST.

In Compound Interest the interest is allowed to accumulate after it becomes due, and form part of the principal; e.g. the compound interest on £400 for 3 years at 5 per cent. would be $£400 + £20 = £420$. This would form the principal for the second year, the interest of which would be £21, therefore the principal for the third year would be £441, the interest on which is £22 1s.; this, added to the last year's principal, would be $£441 + £22 \text{ 1s.} = £463 \text{ 1s.}$ = the amount of £400 for 3 years at 5 per cent. compound interest, therefore the compound interest would be equal to $£463 \text{ 1s.} - £400 = £63 \text{ 1s.}$ This may be obtained by a simpler process; thus, 5 per cent. is equal to $\frac{1}{20} = \frac{1}{20}$, and $1 + \frac{1}{20} = \frac{21}{20}$, the amount of £1 for 1 year at 5 per cent. Now, adding $\frac{1}{20}$ of £400 to itself is the same as multiplying £400 by $\frac{21}{20}$, and as compound interest at

5 per cent. is equal to $\frac{1}{20}$ added to the principal as many times as there are years, therefore the amount of £400 compound interest for 3 years at 5 per cent. $= (\frac{21}{20})^3 \times 400$.
 $= £463 \text{ 1s.}$

		£
5	$\frac{1}{20}$	400
		20
5	$\frac{1}{20}$	420
		21
5	$\frac{1}{20}$	441
		22 1
		463 1

If the interest is to be paid half yearly it is the same as double the number of years at half the rate per cent.

If in the preceding example it were required to pay the interest half yearly the amount would be $(1\frac{1}{40})^6 \times 400$. If paid quarterly it would be $(1\frac{1}{80})^6 \times 400$.

Required to know what principal would amount to £463 1s. at 5 per cent. for 3 years.

If we call P the principal we have

$$P \times (\frac{21}{20})^3 = £463 \text{ 1s.}$$

$$P \times \frac{9261}{8000} = \frac{9261}{20}$$

$$\therefore P = \frac{9261}{20} \times \frac{8000}{9261} = 400.$$

If the rate be required, let r = rate, then we have

$$400 r^3 = £463 \text{ 1s.}$$

$$\therefore r^3 = \frac{9261}{20} \times \frac{1}{4000} = \frac{9261}{8000}$$

$$\therefore r = \frac{21}{20} = 1\frac{1}{20}$$

$$\therefore \frac{1}{20} = \text{rate} = 5 \text{ per cent.}$$

If time be required, let n = time, then we have

$$(\frac{21}{20})^n \times 400 = \frac{9261}{20}$$

$$\therefore (\frac{21}{20})^n = \frac{9261}{20} \times \frac{1}{400} = \frac{9261}{8000};$$

we shall consequently find n by multiplying $\frac{21}{20}$ by itself till it is $= \frac{9261}{8000}$ and as $\frac{9261}{8000}$ is the cube of $\frac{21}{20}$, therefore the time is 3 years.

If it should be required to find the amount at compound interest for $3\frac{1}{2}$ years instead of 3 years, we should find it for 3 years, as already shown, and for the half year find the interest on £463 1s. for 1 year at half the rate per cent.

EXERCISE LIX.

Required the Compound Interest and Amount on the following sums:—

- (1) £2666 13s. 4d. at 5 per cent. for 3 years.
 - (2) £500 0s. 0d. at 5 per cent. for 3 years.
 - (3) £28666 13s. 4d. at 5 per cent. for 3 years.
 - (4) £8333 6s. 8d. at 4 per cent. for 3 years.
 - (5) £3906 5s. 0d. at 4 per cent. for 4 years.
 - (6) £5000 0s. 0d. at 4 per cent. for 3 years.
 - (7) £1800 0s. 0d. at 5 per cent. for 4 years.
 - (8) £981 6s. 8d. at $3\frac{3}{4}$ per cent. for 3 years.
 - (9) £421875 0s. 0d. at $5\frac{1}{2}$ per cent. for 3 years.
 - (10) £136533 6s. 8d. at $3\frac{3}{4}$ per cent. for 4 years.
 - (11) £10000 0s. 0d. at 5 per cent. for 6 years.
 - (12) £166666 13s. 4d. at $3\frac{1}{2}$ per cent. for 3 years.
 - (13) £2700 0s. 0d. at $3\frac{1}{2}$ per cent. for 3 years.
 - (14) £1466666 13s. 4d. at 5 per cent. for 6 years.
 - (15) £34166 13s. 4d. at $3\frac{1}{2}$ per cent. for 3 years.
 - (16) £540000 0s. 0d. at $3\frac{1}{2}$ per cent. for 4 years.
 - (17) £83333 6s. 8d. at $5\frac{1}{2}$ per cent. for 4 years.
 - (18) £651041 13s. 4d. at $4\frac{1}{2}$ per cent. for 3 years.
 - (19) £266666 13s. 4d. at $4\frac{1}{2}$ per cent. for 3 years.
 - (20) £325520 16s. 8d. at $4\frac{1}{2}$ per cent. for 3 years.
 - (21) £12656 5s. 0d. at $6\frac{3}{4}$ per cent. for 4 years.
 - (22) £263671 17s. 6d. at $5\frac{1}{2}$ per cent. for 4 years.
 - (23) £147666 13s. 4d. at 5 per cent. for 6 years.
 - (24) £13644000 0s. 0d. at $3\frac{1}{2}$ per cent. for 5 years.
 - (25) £60722656 5s. 0d. at $4\frac{1}{2}$ per cent. for 4 years.
 - (26) £1500 0s. 0d. at 4 per cent. for 3 years.
 - (27) £15400 0s. 0d. at $2\frac{1}{2}$ per cent. for 2 years.
 - (28) £750 0s. 0d. at $2\frac{1}{2}$ per cent. for 5 years.
 - (29) £990 0s. 0d. at $3\frac{3}{4}$ per cent. for 4 years.
 - (30) £10000 0s. 0d. at $3\frac{1}{2}$ per cent. for 5 years.
-

PROFIT AND LOSS.

In **Profit and Loss**, if profit is made, the selling price must exceed the buying price, or, as it is generally called, the cost price.

If loss, the selling price will be less than the cost price; consequently the selling price is = cost price plus gain, or cost price minus loss.

By selling goods at 2s. 9d. per yard, a person gains 10 per cent.; what was the cost price?

If 10 per cent. is gained, that is equal to $\frac{1}{10}$ of the cost price;

$$\therefore 1\frac{1}{10} = 2s. 9d. \therefore \frac{11}{10} = 33d. \therefore \frac{10}{10} \text{ or } 1 = 30d. = 2s. 6d. = \text{C. P.}$$

By selling goods at 2s. 3d. a person loses 10 per cent.; what is the cost price?

In this instances $\frac{1}{10}$ is lost $\therefore 1 - \frac{1}{10} = \frac{9}{10} = 27d. \therefore \frac{10}{10} \text{ or } 1 = 30d. = \text{C. P.}$

How must a person sell goods which cost 3s. 4d. to gain 5 per cent.?

5 per cent. = $\frac{1}{20}$. Now, as $\frac{21}{20}$ or 1 = 3s. 4d., what will $\frac{21}{20}$ be equal to?

$$\begin{array}{ccc} 1 & : & \frac{21}{20} \\ 2 & & \\ \frac{21}{20} \times \frac{20}{1} & = & 42d. = 3s. 6d. \end{array}$$

If goods are bought at 3s. 4d. and sold at 4s. 6d., what is the gain per cent.?

As 1s. 2d. is gained on 3s. 4d., what is gained on £100?

$$\begin{array}{ccc} \text{£} & & \text{£} \\ 3\frac{1}{2} & : & 100 \\ 3 & \times 20 & 6 \\ \frac{10}{3} & & \frac{7}{6} \times \frac{1}{20} \\ 5 & & \\ \frac{3}{10} \times \frac{100 \times 20}{1} \times \frac{7}{6} \times \frac{1}{20} & = & 35 \text{ per cent.} \end{array}$$

If by selling goods at 3s. 2d. a person loses 5 per cent., for what must he sell them to gain 10 per cent.?

5 per cent. = $\frac{1}{20}$ \therefore 38d. = $\frac{19}{20}$ } required to find the value of $\frac{19}{20}$ or 1.

$$\frac{19}{20} : 1 :: 38d. : \frac{20}{19} \times 38d. = 40d. = 3s. 4d. \text{ cost price.}$$

If $\frac{19}{20}$ or 1 = 40d., what does 1 + $\frac{1}{10}$ equal?

$$1 : 1\frac{1}{10} :: 40d.$$

$$\frac{11}{10} \times 40d. = 44d. = 3s. 8d.$$

EXERCISE LX.

(1) By selling goods at 1s. 9d. I gain 5 per cent.; what is the cost price?

(2) By selling goods at 3s. 2d. I lose 5 per cent.; required the cost price.

(3) By selling goods at 11s. I gain 10 per cent.; what is the cost price?

(4) By selling goods at £4 10s. I lose $6\frac{1}{4}$ per cent.; required the cost price.

(5) If by selling wine at 19s. per gallon I lose 5 per cent., at what price must I sell it to gain 15 per cent.?

(6) By selling cloth at 12s. a yard I lose 8 per cent.; what do I gain or lose by selling it at 15s. a yard?

(7) If I buy a 9 gallon cask of beer at 15s. and sell it at 2s. a gallon, what do I gain per cent.?

(8) If by selling wine at 16s. I lose 4 per cent., at what must I sell it to gain 20 per cent.?

(9) If a butcher buys a bullock at 5s. 4d. the stone, and sells it at 6s. the stone, what will be his gain per cent.?

(10) If butter is sold at the rate of 1s. 6d. the lb., how much should be sold for 2s. 3d. to gain 50 per cent.?

(11) A merchant by selling tea at £35 a cwt. gains 25 per cent.; what was his prime cost per lb.?

(12) If sugar be bought at 5d. per lb., at what must it be sold to gain 20 per cent.?

(13) If tea be bought at 4s. 6d. and sold at 5s. 3d., what is the gain per cent.?

(14) If I buy cloth at 15s. a yard, what will be the loss per cent. by selling it at 13s. 6d.?

(15) By selling an article at £11 8s. the vendor loses 5 per cent.; what will be the gain or loss by selling it at £11 11s.?

(16) By buying cloth at 12s. 6d. a yard, and selling it at 14s. 9d., what is the gain per cent.?

(17) If by selling tea at 5s. per lb. you gain 25 per cent., what will you gain or lose by selling it at 4s. 6d.?

(18) A merchant bought teas at 3s. 3½d. and 5s. 4d. per lb., and mixes them in proportion of 4 of the former to 3 of the latter. He sells the mixture at 4s. 10d. per lb.; what does he gain or lose per cent.?

(19) A man buys 35 sheep for 50 guineas, and sells 15 of them so that he loses 5 per cent. by the sale; at what price per sheep must he sell the remainder to gain 15 per cent. on the whole purchase?

(20) By selling wine at 30s. a dozen a merchant clears $\frac{1}{10}$ of his outlay; he then raises the price to 36s. a dozen; what does he clear per cent. on his outlay at the latter price?

(21) By selling cloth at 15s. a yard the vendor loses at the rate of 10 per cent.; at what price per yard must it be sold to realise a profit of 20 per cent.?

(22) If 1 ton 2 cwt. 0 qrs. 18½ lbs. of sugar cost £68 19s. 2d., at what rate per lb. must it be sold to realise a profit of 20 per cent.?

(23) If by selling tea at 4s. 8d. per lb. you gain 25 per cent., what will you gain or lose by selling it at 3s. 4d.?

(24) If a chest of tea weighing 125 lbs. cost £20 6s. 3d., at what rate per lb. must it be sold to gain 20 per cent.?

(25) If 5 per cent. be lost by selling an article at 10s., what will be the gain or loss by selling it at 12s. 6d.?

(26) A wine merchant mixes 1 pipe of wine at £88 4s. per pipe with a pipe at £63, and sells it at 36s. per dozen (at 2 gallons to the dozen); what is his entire gain and gain per cent.?

(27) A hop factor bought 400 pockets of hops, each weighing 1¼ cwt.; he sold 120 pockets at £13 4s. a cwt., and found he was thereby gaining 10 per cent.; at what rate per cwt. must he sell the remaining 280 pockets to clear 17½ per cent. on the whole?

(28) A corn merchant bought 300 qrs. of wheat, of which he sold 100 qrs. at 42s. a qr., and found that he was thereby gaining 5 per cent.; at what rate must he sell the remaining 200 qrs. to clear 15 per cent. on the whole?

(29) A grocer mixes 5 cwt. of coffee at £5 2s. 8d. per cwt. with 2 cwt. of chicory at £2 13s. 8d. per cwt., and retails the mixture at 1s. 7d. per lb., what is his entire gain and gain per cent.?

(30) Bought 120 sheep at £3 5s. a head, sold 30 of the inferior at £2 15s. a head; at what price must the remainder be sold to gain 15 per cent. on the whole?

STOCKS.

Stock is the term principally applied to any portion of the National Debt when considered as property that may be transferred from one person to another. It is also used to designate money lent to railway and other trading companies.

Stocks are said to be **At Par** when £100 cash will purchase £100 stock; **Below Par** when £100 stock costs less than £100; and **Above Par** when £100 stock costs more than £100.

The price of stock varies with the state of public events, as the probability of war or great political changes.

If government borrowed a certain sum of money at $3\frac{1}{2}$ per cent., and sound securities returned 4 per cent., then this stock would be below par, or worth only £87 10s., because if £100 would produce £4 it would require only £87 10s. to produce £3 $\frac{1}{2}$, and the $3\frac{1}{2}$ per Cents. would then be said to be at 87 $\frac{1}{2}$. From this we see that the interest is always paid on the stock, not on the sterling value.

The dividends on stock are paid half yearly, and are due January 5th and July 5th or April 5th and October 5th.

Stocks are bought and sold by stockbrokers, who receive for their trouble a commission of about 2s. 6d. per cent. Stockbrokers besides their legitimate business make what are called time bargains; the seller expecting the price will be less at some stated period than at the time he sells, and the buyer anticipating a rise; no stock changes hands but simply the difference is paid. In fact, it is merely a bet how much the stocks will rise or fall in a given time. The sellers of time bargains are called 'bears' and the buyers 'bulls.'

What quantity of stock will a person obtain by investing £5000 in the $3\frac{1}{2}$ per Cents. at $87\frac{1}{2}$, and what income will he derive therefrom?

As $£87\frac{1}{2}$ is equal to 100 stock, therefore the number of 100's stock in £5000 = $\frac{5000}{87\frac{1}{2}}$, therefore the quantity of stock = $\frac{5000}{87\frac{1}{2}} \times 100 =$

$$\frac{1000}{1} \times \frac{2}{175} \times \frac{100}{1} = \frac{40000}{7} = 5714\frac{2}{7} \text{ stock.}$$

As the number of 100's stock = $\frac{5000}{87\frac{1}{2}}$, therefore the income will be

$$\frac{5000}{87\frac{1}{2}} \times 3\frac{1}{2} = \frac{5000}{1} \times \frac{7}{175} \times \frac{7}{2} = £200.$$

What sum of money must be given for £3000 in the $3\frac{1}{4}$ per Cents. at $81\frac{3}{4}$?

$\frac{3000}{100} = 30$, the number of 100's of stock, and as each 100 is worth $£81\frac{3}{4}$, therefore $81\frac{3}{4} \times 30 = \frac{327}{4} \times \frac{30}{1} = \frac{4905}{2} = £2452 \text{ 10s.}$

What is the price of stock when a person can purchase £1000 stock for £850?

As £1000 stock is worth £850, therefore the value of stock in sterling money is $\frac{850}{1000} = \frac{17}{20}$, and $\frac{17}{20}$ of $\frac{100}{1} = £85 =$ the value per cent.

What is the value of money per cent. when the $3\frac{1}{2}$ per Cents. are at $87\frac{1}{2}$?

As the interest of $£87\frac{1}{2}$ is equal to $£3\frac{1}{2}$ you get $\frac{1}{25}$ of your capital; for $\frac{3\frac{1}{2}}{87\frac{1}{2}} = \frac{1}{25}$, and $\frac{1}{25}$ of 100 = 4 = the value of money per cent.

When the $3\frac{1}{2}$ per Cents. are 98, what must be the price of another stock that yields $4\frac{1}{2}$ per cent., so that you may invest in either with equal advantage?

$$£3\frac{1}{2} : £4\frac{1}{2} :: £98$$

$$\frac{2}{1} \times \frac{9}{2} \times \frac{14}{1} = £126 = \text{the price of the stock.}$$

In which will it be most advantageous to invest: in the 3 per Cents. at $88\frac{1}{2}$, or in the $3\frac{1}{2}$ per Cents. at $99\frac{1}{2}$?

In the first instance you get $\frac{3}{88\frac{1}{2}} = \frac{2}{55}$ of your capital.

„ second „ „ $\frac{3\frac{1}{2}}{99\frac{1}{2}} = \frac{1}{27}$ „ „

It is therefore more advantageous to invest in the 3 per Cents.

What must be the market value of the 3 per Cents. stock in order that, after deducting an income tax of 10*d.* in the pound, it may yield $3\frac{1}{2}$ per cent. interest?

An income tax of 10*d.* in the pound $= \frac{10}{240} = \frac{1}{24}$ of your income, $\frac{1}{24}$ of £3 $= £\frac{1}{8}$ = the income tax on £3; therefore the net income received from £100 Stock $= £3 - \frac{1}{8} = £2\frac{7}{8}$; but by the question £100 sterling will produce £3 $\frac{1}{2}$ after deducting income tax. It is therefore required to find what sterling money will produce £2 $\frac{7}{8}$.

$$\begin{array}{rcl}
 \text{£} & & \text{£} \\
 3\frac{1}{2} & : & 2\frac{7}{8} \\
 2 & & 8 \\
 \hline
 7 & & 23 \\
 2 & & 8 \\
 & & 25 \\
 \frac{2}{7} \times \frac{23}{8} \times \frac{100}{1} & = & \frac{575}{7} = £82\frac{1}{7}.
 \end{array}$$

If the 3 per Cents. be at 90, how much must I invest in them in order to have a yearly income of £1165, after paying 7*d.* in the pound income tax?

7*d.* in the pound $= \frac{7}{240}$ of income,

$\therefore \frac{240}{240} - \frac{7}{240} = \frac{233}{240} = £1165$ = income after paying 7*d.* in the pound.

$$\frac{233}{240} : 1 :: £1165$$

$$\frac{240}{233} \times \frac{1165}{1} = 1200 = \text{income before paying tax.}$$

$$£3 : £1200 :: £90$$

$$\frac{400}{1200} \times 90 = £30000 = \text{the sum to be invested.}$$

EXERCISE LXI.

(1) What sum of money must be given for £1900 stock in the $3\frac{1}{2}$ per Cents. at $89\frac{3}{8}$?

(2) What sum of money must I invest in the 4 per Cents. at 90 to produce an income of £495 19s. 9d.?

(3) If £2100 be invested in the 5 per Cents. at 105, required the amount of stock, and the annual income derived therefrom?

(4) What income will a person have by investing £3600 in the $3\frac{1}{2}$ per Cents. at 90?

(5) What would he gain in the last example by the stock's rising $\frac{1}{8}$ per cent.?

(6) What sum of money must be given for £4500 stock in the $3\frac{1}{2}$ per Cents. at $81\frac{3}{4}$?

(7) If £800 stock in the $2\frac{3}{4}$ per Cents. at $76\frac{1}{8}$ be sold out, how much sterling money will be obtained?

(8) If a person invests £1800 in the 4 per Cents. at 90, what amount of stock would he obtain, and what would be his annual income?

(9) What is the price of stock per cent. when a person can purchase £1000 stock for £900?

(10) What sum of money must be given for £3000 stock in the $4\frac{1}{2}$ per Cents. at $96\frac{1}{2}$, and what would a person gain by selling out at par?

(11) What sum of money must a person invest in the 4 per Cents. at 90 to produce an income of £100?

(12) If a person invests £3950 in the $3\frac{1}{2}$ per Cents. at $98\frac{3}{4}$, what amount of stock would he obtain?

(13) A person engaged a broker to purchase £2000 stock in the 3 per Cents. at 85, allowing him $\frac{1}{8}$ per cent.; what sum of money must he give him?

(14) What would a person lose if, having £1000 stock in the $3\frac{1}{2}$ per Cents. at 75, the stock fell 1 per cent.?

(15) What would be the difference in an income made by the transfer of £7700 stock from the $2\frac{3}{4}$ per Cents. at 70, to the $4\frac{1}{2}$ per Cents. at 98?

(16) A person invests £1000 in the 3 per Cents. at 75, and on their rising to $75\frac{3}{4}$ sells out; find the entire gain, and the gain per cent. on his original outlay.

(17) A person transfers £4500 stock from the 3 per Cents. at 72 to the 4 per Cents. at 90; what is the difference in the income?

(18) What sum must a person invest in the $3\frac{1}{2}$ per Cents. at 84 to produce an income of £666?

(19) In which is it most advantageous to invest: in the 3 per Cents. at 80, or the $3\frac{1}{2}$ per Cents. at 96?

(20) What is the price of stock per cent. when a person can purchase £12000 stock for £10000?

(21) If a person invests £3000 in the 4 per Cents. at 90, and on their rising to $90\frac{1}{2}$ sells out, what is his gain?

(22) If a person lays out £30000 in the $3\frac{1}{2}$ per Cents. at 90, at what price should they be sold out to produce a gain of £1000?

(23) A person invests £9000 in the 3 per Cents. at 72, and on their rising to $72\frac{1}{2}$ sells out, and puts it at compound interest for 2 years at $4\frac{1}{2}$ per cent. He then invests it in the 4 per Cents. at 88. What is the difference in his income?

(24) A person invests £8600 in the $3\frac{1}{2}$ per Cents. at 86, and on their rising to $86\frac{1}{2}$ sells out, and invests in the 5 per Cents. at 120; what is the difference in his income?

(25) A person has £10000 stock in the 3 per Cents. at 85; what sum must he also have in the $3\frac{1}{2}$ per Cents. at 90 to produce an income of £1000?

(26) How much stock must be bought at 80 in order that, by selling out at 81, £50 may be gained?

(27) A person invests £3240 in the 3 per Cents. at 81, and on their rising to $81\frac{1}{4}$ sells out; find his gain.

(28) A person has £50000 stock in the 4 per Cents. at 90; what stock must he have in the $4\frac{1}{2}$ per Cents. at 95 to produce an income of £9992?

(29) A person invests £1000 in the 3 per Cents. at 80, and on their rising to $80\frac{1}{4}$ sold out; what is his entire gain?

(30) If a person receives 5 per cent. interest on his capital by investing in the 4 per Cents., what is the price of the stock, and what income will he obtain by investing £4000?

(31) How much money must a person invest in the funds when Consols are at 96, so as to get the same income as if he had invested £3300 when Consols are at 99?

(32) If the 4 per Cents. are at 90, how much money must a person invest in order that he may have a yearly income of £770?

(33) A person invests £5050 in the $3\frac{1}{2}$ per Cents. at 80, and on the stock's falling $1\frac{1}{4}$ per cent. sells out; find what is his loss.

(34) When a certain stock is at 95 a person possesses what would realise £4000; find what quantity of another stock at 80 he ought to receive in exchange for it.

(35) If a person invests £2000 in the 3 per Cents. at 80; at what price should they be sold to produce a gain of £200?

(36) In which is it most advantageous to invest: in the $3\frac{3}{8}$ per Cents. at 81, or in the 4 per Cents. at 90?

(37) A sum of £4000 is invested in the 3 per Cents. at 80, but on their rising $\frac{1}{8}$ per cent. is sold out, and then put at simple interest for 4 years at 4 per cent. ; find the entire gain, and gain per cent.

(38) A sum is laid out in the 4 per Cents. at $90\frac{1}{2}$ and sold out at 95; the gain being £2000, find the sum laid out?

(39) The sum of £3500 was laid out in the $3\frac{1}{2}$ per Cents. at 84, and a half year's dividend having been received upon it, it was sold out, the gain being £416 13s. 4d. ; find at what price it was sold out.

(40) How much stock must be bought at 75 in order that, by selling out when the stocks are at 77, £45 may be gained?

(41) How much money must be invested in the $3\frac{1}{2}$ per Cents. at 81 in order that, by selling out at 84, £66 13s. 4d. may be gained?

(42) What must be the price of 3 per Cents. so that, after deducting an income tax of 4d. in the £, they may yield $3\frac{1}{2}$ per cent. interest?

PROPORTIONAL PARTS.

Fellowship and Partnership and many nondescript examples are very simply worked by what is generally denominated Proportional Parts.

The principle of working is best illustrated by examples.

Divide £600 between 3 persons in the ratio of 3, 4, and 5.

It is evident if one is to have 3 parts, another 4, and another 5, the number must be divided by the number represented by the sum of 3, 4, and 5, and the first will have 3, the second 4, and the last 5 of these parts.

$$\begin{array}{rcl}
 & 50 & \\
 \frac{3}{12} \text{ of } \frac{600}{1} & = & 150 \\
 & 50 & \\
 \frac{4}{12} \text{ of } \frac{600}{1} & = & 200 \\
 & 50 & \\
 \frac{5}{12} \text{ of } \frac{600}{1} & = & 250 \\
 \hline
 & & \underline{\underline{£600}}
 \end{array}$$

A bankrupt owes 3 creditors £620, £470, and £380 respectively ; his assets amount to £408 16s. 10½d; what will be each creditor's share, and what will he pay in the pound ?

Dividing by 10, the ratio will be 62, 47, 38 = 147.

$$\frac{62}{147} \text{ of } \frac{1335}{1} = 82770 \text{ halfpence} = £172 \text{ 8s. 9d.}$$

$$\frac{47}{147} \text{ of } \frac{1335}{1} = 62745 \text{ halfpence} = £130 \text{ 14s. 4½d.}$$

$$\frac{38}{147} \text{ of } \frac{1335}{1} = 50730 \text{ halfpence} = £105 \text{ 13s. 9d.}$$

£	£	£	s.	d.
1470	:	1	::	408 16 10½
				20
				8176
				12
				98122
				4
				392490

$$\frac{267}{392490} \times 1 = 267 \text{ farthings} = 5s. 6½d., \text{ what he pays in the pound.}$$

Two merchants, *A* and *B*, engaged in business with capitals in the ratio of 5 : 7 ; at the end of 5 months they withdraw $\frac{1}{5}$ and $\frac{1}{7}$ of their capitals respectively. Their entire gain during the year was £3092 ; what was the share of each ?

$$5 \times 5 = 25 = \text{A's profit for 5 months.}$$

$$7 \times 5 = 35 = \text{B's " "}$$

$$\{5 - (\frac{1}{5} \text{ of } 5)\} \times 7 = 28 = \text{A's profit for 7 months.}$$

$$\{7 - (\frac{1}{7} \text{ of } 7)\} \times 7 = 40\frac{5}{8} = \text{B's " "}$$

$$25 + 28 = 53 = \text{A's capital for the year.}$$

$$35 + 40\frac{5}{8} = 75\frac{5}{8} = \text{B's " "}$$

$$\therefore \text{A's capital : B's capital} :: 53 : 75\frac{5}{8} :: 318 : 455.$$

$$\left. \begin{array}{l} 318 \\ 455 \\ 773 \end{array} \right\} \frac{318}{773} \times £ \frac{3082}{1} = £1272$$

$$\frac{455}{773} \times £ \frac{3082}{1} = £1820.$$

Divide 3348 into parts, in the ratio of $\frac{8}{3}$, $\frac{9}{4}$, and $\frac{10}{5}$.

$$\frac{8}{3}, \frac{9}{4}, \frac{10}{5} = \frac{8, 9, 10}{12} \text{ and } 8 + 9 + 10 = 27.$$

$$\frac{8}{27} \text{ of } \frac{3348}{1} = 992.$$

$$\frac{9}{27} \text{ of } \frac{3348}{1} = 1116.$$

$$\frac{10}{27} \text{ of } \frac{3348}{1} = 1240.$$

EXERCISE LXII.

(1) A father divides £30000 amongst his three sons, in the ratio of 3, 2, and 1; what was the share of each?

(2) Divide £1214 8s. 9d. between 5 persons, in the ratios of $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{7}$.

(3) How much fine gold will there be in a mixture containing 2 oz. 18 carats fine, 3 oz. 15 carats fine, and 2 oz. 12 carats fine; and what will be the fineness of the mass?

(4) Three families hire a furnished house for a year, at a rent of £130; they agree to pay according to the time each occupies the house, viz. 22, 13, and 17 weeks respectively; what was the rent paid by each?

(5) A person left property (which he considered worth £10000) to six charities, in the following sums: £2500, £2000, £1800, £1500, £1300, and £900; when sold, the property only realised £9420; what did each charity receive?

(6) A merchant commences business with £2000; in 4 months he was joined by a partner who brought in £2800; and at the end of 6 months a third partner joined with £1800; at the end of the year they had gained £1859: what was the share of each?

(7) A and B engage in business with capitals in the ratio of 11:13; at the end of 10 months A withdraws $\frac{1}{3}$ of his capital, and at the end of

15 months $B \frac{1}{3}$. After being in business 2 years they divide their profits, which amount to £1813; find the share of each.

(8) Two persons rent a field of $27\frac{1}{2}A$ for £38; one puts 30 sheep in for 6 weeks, and the other 20 for 10 weeks; they agree to pay the rent and receive the profits according to the feed taken by each; they clear £57 by the sale of the hay; what are the profits of each?

(9) Required the quantity of pure silver and copper in 1 ton of sterling silver, which is composed of 37 parts of pure silver to 3 of copper; and if 1 lb. Troy will coin 66 shillings, what will be the value of a ton, and what equal number of half-crowns, shillings, fourpenny and threepenny pieces can be coined from it?

(10) Gunpowder is composed of 75 parts of nitre, 10 of sulphur, and 15 of charcoal; how much of each ingredient is required in the manufacture of 1 ton?

(11) A wine merchant mixes 3 qualities of wine in proportions of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$, with $9\frac{1}{2}$ gallons of brandy; what was the quantity mixed, and the number of gallons of each?

(12) A field containing 15A. 3R. 30P. is divided into 60 cottage gardens in three sets of 20 each, in the ratios of 9, 10, and 11; required the size of the different gardens.

(13) A tea dealer mixes teas in the ratio of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$ with as many pounds of another sort as would make a whole number, and the mixture cost £47 5s.; how many pounds of each did he mix, and what did each cost him, the price being in the ratios of the quantities; required the gain per cent., the mixture being sold at 3s. 8d. per lb.?

(14) 3 drovers hired a pasture for 9 weeks for £23, for which they agreed to pay according to the time and number of cattle grazed. A put in 30 oxen for 22 days, B 24 for 25 days, and C 45 for 18 days; how much did each pay?

(15) A bell, weighing 7 tons 11 cwt. 3 qrs. 23 lbs., was composed of copper, tin, and zinc, in the proportions of $\frac{4}{5}$, $\frac{1}{5}$, and $\frac{1}{10}$; how much of each metal was used, and what did it cost, at £7 9s. 4d. per cwt.?

(16) 3 merchants, A, B, and C, subscribe a capital in the ratio of 5, 7, and 9; at the end of 3 months, A adds $\frac{1}{2}$ of his original capital; at the end of 9 months B adds $\frac{1}{3}$ of his original capital; and at the end of 8 months C adds $\frac{1}{4}$ of his original capital; at the close of the year they have gained £3459; how must they divide their profits?

(17) A can do a piece of work in 30 hours, B in 28 hours, and C in 24 hours; A works by himself 5 hours, he is then joined by B, and they work together 5 hours more, they are then joined by C; required the time it will take them (all working together) to finish it.

(18) In an orchard, $\frac{3}{8}$ of the trees are apple trees, $\frac{1}{4}$ pear trees, $\frac{1}{8}$ plum trees, and there are 10 cherry trees; required the number of each.

(19) *A*, *B*, and *C*, who work in the ratio of $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, mow a field containing 9A. 2R. 31P. for which they receive £2 10s. 11d.; how much does each cut, and what does each receive?

(20) A goldsmith purchases 3 oz. 10 dwts. 15 grs. of gold, at £1 11s. 10 $\frac{1}{2}$ d. per oz.; 2 oz. 3 dwts. 17 grs., at £2 2s. 5 $\frac{1}{4}$ d. per oz.; 1 oz. 12 dwts. 10 grs., at £2 13s. 1 $\frac{1}{4}$ d. per oz.; and 2 oz. 17 dwts. 15 grs., at £3 3s. 8 $\frac{1}{2}$ d. per oz.; what is the fineness of the different golds mixed; and how much fine gold must be added to make the mass 15 carats fine, and what proportion will each quantity bear to the mass?

EXCHANGE.

Exchange is the rule by which we ascertain how much money of one country is equivalent to a given sum of the money of another.

By **Par of Exchange** is meant the value of the coins of one country expressed in the coins of another. This value entirely depends on the quantity of pure metal in the coin, whether gold or silver, the alloy in no instance being considered of any value.

Par of Exchange is variable in countries which do not use the same metal as a standard: e. g. the standard in England is gold, in France silver; consequently the par of exchange between England and France varies with the price of silver, which averages about 5s. per oz., and is very rarely below 4s. 10 $\frac{1}{2}$ d. or above 5s. 1d. per oz. standard, which contains 444 grs. pure silver. As a franc contains 69.4 grs. of pure silver the exchange is easily calculated. There can be no par of exchange with our silver coin, as the conventional value never alters, 66 shillings being always coined from 1 lb. Troy, which gives 5s. 6d. per oz. as the fixed Mint value.

As gold is now a legal tender in America the par of exchange has been fixed at 4.87 dollars to the £, consequently 10 dollars are equal to £2 1s. 0 $\frac{1}{4}$ d., and 487 dollars are equal to £100.

Franc of France	=	69.4	pure silver
Mark of Hamburg	=	105.5	" "
Florin of Amsterdam	=	146.8	" "
Dollar of America	=	370.1	" "

From the above table it is easy to find the value of a sovereign ('English' par of exchange) in either French, Hamburg, or Amsterdam money, or to find the par of exchange between the respective countries mentioned in the table.

No invariable par of exchange can exist between two countries, for the par varies with the demand for bills of exchange: e. g. If France imported largely from Great Britain there would be a great demand in France for bills of exchange, consequently the price would rise. Supposing the price had been 25.5 francs per £ and it rose to 25.75 francs per £, we should say the exchange was against France; for a French merchant who bought £100 of goods in England would have to pay 25 francs more when the exchange was at 25.75 than he would when it was at 25.5. Again, any English merchant who owed money in France would be able to pay $\frac{1}{4}$ franc more with £1 when the exchange was at 25.75 than when at 25.5.

Required the value of a franc when the rate of exchange is 25.35 francs per £.

$$240 + 25\frac{7}{20} = \frac{507}{1} \times \frac{20}{507} = \frac{1000}{169} = 9.46.$$

Find the value in francs of £3263 13s. 9d. at 25 francs 60 centimes per £.

£	£	s.	d.	fr.
1	:	3263	13 9	:: 25 $\frac{3}{4}$
x 240		20		5
		65273		128
		12		5
52219	8	783285		
158857	18	fr.		
783285	x 128	417752	fr.	fr. cents.
240 x 5		5	= 83550 $\frac{3}{4}$	= 83550 40
30				
18				
5				

If £3 = 20 thalers, 25 thalers = 93 francs, 27 francs = 5 scudi, and 62 scudi = 135 gulden; how many gulden = £1?

Let x = the number of gulden, then we have

$$\begin{array}{rcl} 3 = 20 & \therefore x \times 62 \times 27 \times 25 \times 3 = 20 \times 93 \times 5 \times 135 \\ 25 = 93 & 10 \quad 31 \quad 27 \\ 27 = 5 & \therefore x = \frac{20 \times 93 \times 5 \times 135}{62 \times 27 \times 25 \times 3} = 10 \text{ gulden} \\ 62 = 135 & \\ x = 1 & \end{array}$$

$$\therefore x = 10 \text{ gulden.}$$

This method of working exchange is generally known as the chain rule.

A person in London owes another in St. Petersburg 920 roubles, which must be remitted through Paris. He pays the requisite sum to his broker at a time when the exchange between London and Paris is 25·15 francs for £1, and between Paris and St. Petersburg 1·2 francs for 1 rouble. The remittance is delayed until the rates are 25·35 francs for £1, and 1·15 francs for 1 rouble. What does the broker gain or lose by the delay?

In the first instance we have

$$\begin{array}{l} 1 \text{ rouble} = 1\cdot2 \text{ franc} \\ 25\cdot15 \text{ francs} = £1 \\ \therefore x £ = 920 \text{ roubles} \\ \therefore x \times 25\cdot15 = 920 \times 1\cdot2 \\ \therefore x \times \frac{503}{20} = 920 \times \frac{6}{5} \end{array}$$

$$\therefore x = \frac{920 \times 6 \times 20}{503 \times 5} = \frac{£22080}{503} = £43\frac{451}{503} = \text{the sum paid by the merchant to the broker.}$$

$$\begin{array}{l} 1 \text{ rouble} = 1\cdot15 \text{ franc} \\ 25\cdot35 \text{ francs} = £1 \\ \therefore x £ = 920 \text{ roubles} \\ \therefore x \times \frac{507}{20} = 920 \times \frac{23}{20} \\ \therefore x = \frac{920 \times 23 \times 20}{507 \times 20} = \frac{£41372}{507} \end{array}$$

$$£43\frac{451}{503} - 41\frac{372}{507} = £2 \text{ 3s. } 2\frac{1}{2}d. \text{ nearly} = \text{broker's gain.}$$

The exchange of commodities may be worked by the same method.

If 4 bushels of wheat are worth 6 bushels of barley; 3 bushels of barley worth 4 bushels of oats; 2 bushels of oats worth 3 bushels of potatoes; how many bushels of potatoes may be had for 6 bushels of wheat?

$$\begin{array}{rcl} 4 = 6 & x \times 2 \times 3 \times 4 = 6 \times 3 \times 4 \times 6 \\ 3 = 4 & 3 \\ 2 = 3 & \therefore x = \frac{6 \times 3 \times 4 \times 6}{2 \times 3 \times 4} = 18 \text{ bushels of potatoes.} \\ x = 6 & \end{array}$$

EXERCISE LXIII.

(1) What is the value in English money of the franc when the rate of exchange is 25·45 francs per £ sterling?

(2) If the value of a franc is 9·5*d.*, how many will be required to pay a bill of £102 16*s.* 9*d.*?

(3) An American merchant buys in England £750 worth of goods: what will be the value in dollars?

(4) A merchant in London owes a debt of 1000 pistoles to one in Cadiz: find what he gains by sending it to him through France, the exchange being £1 = 25·4 francs, 19 francs = 1 Spanish pistole, 4 Spanish pistoles = £3.

(5) The exchange between St. Petersburg and London is 6·2 roubles for £1; between St. Petersburg and Paris, 4·25 francs for a rouble; between Paris and London 25·25 francs for £1: what advantage would an English merchant have by paying £1000 through Paris?

(6) If 1 ducat = 11 roubles, 3 roubles = 12 francs, 25 francs = £1, how many £'s will be equal to 50 ducats?

SQUARE ROOT.

In both Square and Cube Root the rule for working only is given, as the rationale may be found in any work on algebra.

Digits.

1, 2, 3, 4, 5, 6, 7, 8, 9.

Squares.

1, 4, 9, 16, 25, 36, 49, 64, 81.

Find the square root of 772641.

$$\begin{array}{r}
 77'26'41 \text{ (879)} \\
 \underline{64} \\
 167) 1326 \\
 \underline{1169} \\
 1749) 16741 \\
 \underline{15741} \\
 \hline
 \hline
 \end{array}$$

RULE.—Divide the number into periods of two, commencing from the right. As 64 is the nearest square to 77, place it under the 77, subtract and bring down the next period. Place 8 in the quotient, as 64 is the square of 8; double this for the trial divisor and see how many times it is contained in all the figures brought down but one; place the number 7 thus found in both divisor and quotient; multiply the divisor by the quotient; subtract from last found dividend and bring down the next period; for the next trial divisor double the quotient or double the last figure in the former divisor; repeat the process till every period is disposed of, or you have obtained as many decimal places as required.

Extract the square root of 523'456 to 3 decimal places.

$$5'23'45'60 \text{ (22'879)}$$

4

$$42) 123$$

$$84$$

$$448) 3945$$

$$3584$$

$$4567) 36160$$

$$31969$$

$$45749) 419100$$

$$411741$$

When the number contains decimals, divide the whole number into periods from right to left, and the decimals into periods from left to right, bringing down a cipher to complete the period, and two more for each succeeding period.

Extract the square root of $606\frac{115}{121}$.

$$7'34'41 \text{ (271)}$$

4

$$\sqrt{606\frac{115}{121}} = \sqrt{\frac{73441}{121}} = \frac{271}{11} = 24\frac{7}{11}.$$

$$47) 334$$

$$329$$

$$541) 541$$

$$541$$

EXERCISE LXIV.

Extract the square root of

- | | | |
|---------------------------|--------------|---------------------------|
| (1) 2704. | (2) 17161. | (3) 20164. |
| (4) 53824. | (5) 128164. | (6) 341056. |
| (7) 883600. | (8) 946729. | (9) $1\frac{225}{2116}$. |
| (10) $38\frac{12}{121}$. | (11) 106'09. | (12) 3'4596. |

- | | | |
|-----------------------------|--------------------------------|-------------------------------|
| (13) 12·5316. | (14) 126·1129. | (15) 7·474756. |
| (16) 12367·6641. | (17) $1\frac{24423}{326041}$. | (18) $5\frac{22124}{32041}$. |
| (19) $944\frac{121}{235}$. | (20) 455721007750129. | (21) 400·8004. |
| (22) $283\frac{9}{289}$. | (23) $350\frac{499}{841}$. | (24) $142\frac{171}{289}$. |
| | (25) $53\frac{4094}{8409}$. | |

Extract the square root correct to six figures.

- | | | |
|-------------------|----------------|---------------|
| (26) 8931·3. | (27) 423·567. | (28) 7324·56. |
| (29) 21934567·45. | (30) 9234·563. | |

Extract the fourth root of

- | | |
|-------------|--------------|
| (31) 28561. | (32) 707281. |
|-------------|--------------|

Extract the eighth root of

- | | |
|---------------|----------------|
| (33) 5764801. | (34) 43048721. |
|---------------|----------------|

CUBE ROOT.

Digits.

1, 2, 3, 4, 5, 6, 7, 8, 9.

Cubes.

1, 8, 27, 64, 125, 216, 343, 512, 729.

Find the cube root of 961504803.

	961'504'803 (987
	729
$9^3 \times 300 = 24300$	232504
$9 \times 8 \times 30 = 2160$	
$8^2 = 64$	
26524	212192
$98^3 \times 300 = 2881200$	20312803
$98 \times 7 \times 30 = 20580$	
$7^2 = 49$	
2901829	20312803

RULE.—Divide the number into periods of three from the right. As 729 is the nearest cube to 961, place it under 961, subtract and bring down the next period; place 9 in the quotient as 729 is the cube of 9. To find the

trial divisor, square the figure in the quotient and multiply by 300; see how many times this trial divisor is contained in all the figures brought down but one, allowing for the great excess of the true divisor over the trial divisor. To complete the divisor, multiply the first figure in the quotient by the last found figure and the product by 30; square the last found figure, add this to the two parts of the divisor already found, and multiply by the last figure in the quotient; subtract this quantity from the dividend and bring down the next period; repeat the process till every period is disposed of. In forming successive trial divisors all the figures in the quotient must be squared before multiplying by 300, and all figures in the quotient must be multiplied by the last found figure before multiplying by 30.

If the quantity contains decimals, point the whole numbers from the right and the decimals from the left, then proceed as explained above.

The cube root of a mixed number may be obtained by reducing it to an improper fraction and extracting the cube root of numerator and denominator.

EXERCISE LXV.

Extract the cube root of

- | | | |
|-----------------------------------|----------------------------------|-------------------------------|
| (1) 2197. | (2) 74088. | (3) 140608. |
| (4) 1030301. | (5) 1906624. | (6) 4492125. |
| (7) 7762392. | (8) 12326391. | (9) 36594368. |
| (10) 187149248. | (11) 806954491. | (12) 991026973. |
| (13) 20·123648. | (14) 34012·224. | (15) 39·651821. |
| (16) 203297·472. | (17) 233744·896. | (18) 618·470208. |
| (19) 663054·848. | (20) 771·095213. | (21) 2809 $\frac{822}{125}$. |
| (22) 977 $\frac{78747}{148877}$. | (23) 11222 $\frac{1123}{5832}$. | (24) 955671·625. |
| (25) 982·107784. | (26) 822656953. | (27) 440711·081. |
| (28) 575·930368. | (29) 633839·779. | (30) 363994344. |

Extract the ninth root of

- | | |
|-----------------|-----------------|
| (31) 134217728. | (32) 387420489. |
|-----------------|-----------------|

MISCELLANEOUS EXAMPLES.

EXERCISE LXVI.

(1) If 1 oz. Apoth. of quinine cost 16s., what will be the price of 1 ton?

(2) Divide £756 13s. 5d. between 3 men and 5 women, giving each woman $\frac{1}{5}$ of a man's share.

(3) Reduce to its lowest terms $\frac{1832642}{2745568}$, and from $(7\frac{1}{2} + 3\frac{1}{2} + \frac{5}{8})$ subtract $(3\frac{1}{2} + 7\frac{1}{10} + \frac{3}{8})$.

(4) The area of a square garden is 464 sq. yds. 5 sq. ft. 112 sq. in.; find one of its sides. Extract the sq. root of 50708641; and the cube root of 938313739.

(5) Find the average of $19\frac{1}{8}$, $12\frac{1}{16}$, $6\frac{1}{32}$, $10\frac{1}{4}$, 428571, $20\frac{3}{4}$, $1\frac{3}{10}$; express the fractional part decimally.

(6) Required the amount at compound interest on £365 14s. 3 $\frac{3}{4}$ d., for 3 years, at 5 per cent.

(7) The circumference of the wheel of a dog-cart is 8 ft. 9 in.; how many revolutions will it have to make in a journey of 10 miles?

(8) What will be the expense of paving a fives court, 20 ft. by 30 ft., at 3s. 9d. per sq. yd.; and how many bricks will it take, each brick measuring 9 in. by 4 $\frac{1}{2}$ in.?

(9) The cost of trenching a square garden, at 4d. per sq. yd., cost £62 10s. 6 $\frac{1}{2}$ d.; required the length of the side.

(10) A straight plank is 2 $\frac{1}{2}$ in. thick and 9 in. broad; what length must be cut off so as to contain 2 $\frac{1}{2}$ cubic ft. of timber?

(11) How much brandy, at 30s. a gallon, must I give for 60 gallons of wine at 18s., so that I may gain 10 per cent. by the exchange?

(12) By selling paper at 15s. a ream, a stationer clears $\frac{1}{5}$ of the money; he then raises the price to 18s.; what does he clear per cent. by the latter price?

(13) Required the expense of lining a cistern which is 6 ft. 3 in. long, 2 ft. 8 in. broad, and 3 ft. 6 in. deep, with lead, weighing 8 lbs. to the sq. ft., at £1 17s. 6d. per cwt.

(14) If 1 $\frac{1}{8}$ ells English cost $\frac{5}{8}$ of a guinea, what will 2 $\frac{1}{8}$ ells Flemish cost, a Flemish ell being $\frac{3}{4}$ of an English ell?

(15) What will be the price of 12 bales of cloth, each containing 538 yds., at £1 12s. 6d. a yd., a reduction of 10 per cent. being made upon $\frac{2}{5}$ of the quantity, and 7 $\frac{1}{2}$ upon the remainder?

(16) By selling cloth at 18s. a yd., a draper clears $\frac{1}{5}$ of his outlay; what does he clear per cent. on his outlay by raising the price to £1?

(17) On winding up the affairs of an insolvent estate, one partner can

pay 18s. $9\frac{1}{2}$ d. in the £, whilst the other only 5s. $4\frac{1}{4}$ d.; the former having private property of the value of £858 18s. 9d., enables him to pay the greater dividend; what are the liabilities of the firm?

(18) *A* and *B* start in trade with capitals in the ratio of 9 : 10; at the end of 4 months they withdraw respectively $\frac{1}{2}$ and $\frac{1}{3}$ of their capitals. How must they divide their profits of £3844 at the end of the year?

(19) What is the value of money per cent. when the $3\frac{1}{2}$ per Cents. are at 84?

(20) $\frac{2}{3}$ and $\frac{2}{3}$ of the pupils of a school left; there remained 390; what was the original number?

(21) *A* can do a piece of work in 15 hours, *B* in 12 hours, and *C* in 10 hours; *A* works by himself 3 hours, he is then joined by *B*, and they work together 3 hours more, after which *C* joins them; how long will it take them to complete the work?

(22) A man rows 7 miles in 2 hrs. 20 min. against a stream, the rate of which is $3\frac{1}{2}$ miles an hour; how long would he be rowing 15 miles with the stream?

(23) If the $3\frac{1}{2}$ per Cents. be at 94, how much must I invest in them in order to have a yearly income of £649, after paying an income tax of 4d. in the £?

(24) What must be a person's annual income who spends £560, and obtains a discount of £1 15s. per month by paying cash, and thus makes an increase on his annual income of 25 per cent.?

(25) The value of a pound of gold is £46 14s. 6d., and the value of a pound of silver £3 6s.; the specific gravity of gold is 19.5, and that of silver 10.5; find the value of a bar of silver equal in bulk to £1869 worth of gold.

(26) What must be the market value of the 4 per Cent. stock, in order that, after deducting an income tax of 6d. in the pound, it may yield $4\frac{1}{2}$ per cent. interest?

(27) What will a farmer's harvest beer cost him, for which he pays 31s. 6d. per barrel? his harvest lasts for 29 days; he employs 12 men, 8 lads, and 8 women; he allows a man 3 pints, a lad 1 quart, and a woman $1\frac{1}{2}$ pints per day. The entire labour cost £113 2s., and he paid the men, lads, and women in the ratio of 7, 5, and 4; what did each receive?

(28) At what price must the 3 per Cent. stock be sold, so that, after deducting an income tax of 4d. in the pound, it may yield 4 per cent. interest?

(29) If from 1 lb. Troy $46\frac{2}{3}$ sovereigns are coined, how many sovereigns can be coined from 10 cwt. 1 qr. 4 lbs. of gold, and what will be the weight Troy?

(30) From the above find the weight of a sovereign, both by Troy and Avoirdupois.

(31) A grocer mixes 20 lbs. of tea at 2s. 6d. per lb., 40 lbs. at 2s., and 60 lbs. at 1s. 9d.; he retails the mixture at 2s. 11½d.; what is his entire gain and gain per cent.?

(32) Find the compound interest on £9666 13s. 4d., at 2½ per cent. for 4 years.

(33) What must be the market value of the 4¾ per Cents. stock, in order that, after deducting an income tax of 4d. in the £, it may produce 5 per cent?

(34) A cask of beer containing 36 gallons cost £1 10s., 6 gallons of which were spilt; at what price must the remainder be sold per gallon in order to gain 25 per cent. on the prime cost?

(35) A gentleman pays a tax of 5 per cent. upon his income; what must his income have been when, after he had paid the tax, he had £4047 remaining?

(36) A certain number of men half finish a piece of work in 30 days; 20 more were employed and finished it in 15 days; how many men were employed at first?

(37) A grocer mixes 80 lbs. of coffee at 1s. 4d. per lb., and 20 lbs. of chicory at 8d. per lb.; he sells the mixture at 1s. 6d. per lb.; what is his entire gain and gain per cent.?

(38) If an oz. of silver cost 5·3s., what will be the price of a bar of silver weighing 2 lbs. 9 oz. 18·125 dwts.?

(39) A and B can do a piece of work in 8 days, A and C in 10 days, and B and C in 12 days; in what time can they do it jointly and separately?

(40) A draper has 100 yards of silk, of which he sells 40 yards at 4s. 6d. per yd., and finds that he is thereby gaining 12½ per cent.; at what rate per yard must he sell the remainder to gain 20 per cent. upon the whole?

(41) Find the value of ·375 of 1½ tons + 4·714285 cwt. + ·571428 of 1¼ qrs. + ·428571 of 18 lbs + ·3 of 5 of ⅞ of 5 oz.

(42) If 10 men, 8 women, 6 boys, working in the ratio of 1, 2, and 3, do a piece of work in 33 days, how long will it take 6 men, 6 women, and 6 boys to do a work 3 times as large?

(43) A gentleman pays £146 a year for his house, his poor rate is 4s. 2d. in the £, paving and lighting 1s. 3d., church rate 4d. in the £; his income tax at 4d. in the £ is ⅓ of his rent; required his income, and find what he pays for rent and taxes.

(44) A person has 117 apple, pear, and plum trees in the ratio of 5, 3, and 1; he sells the apple trees at 4s. 6d. each, ⅓ of the pear trees at 5s.

each, the remainder at 4s. each, 10 of the plum trees were sold for £1 5s., the remainder at 3s. each. How many trees were there of each kind; and if he gained 20 per cent. what did they cost him?

(45) The weights of equal quantities of silver and platinum are as 10·5 and 21·5; and 32 cub. in. of silver with 100 cub. in. of platinum weigh as much as $127\frac{19}{38}$ cub. in. of gold; what number represents proportionally the weight of gold?

QUESTIONS SELECTED FROM THE PAPERS GIVEN FOR
DIRECT COMMISSION, AND FOR ADMISSION TO THE
ROYAL MILITARY COLLEGE, SANDHURST.

EXERCISE LXVII.

(1) Add together the following sums of money: £432 11s. $7\frac{1}{2}$ d., £17 16s. 4d., £3427 2s. $11\frac{1}{4}$ d., £10121 19s. $3\frac{3}{4}$ d.

(2) The sum of £55 6s. $10\frac{1}{2}$ d. is to be equally divided among 35 persons; how much will each person receive?

(3) If a soldier step $\frac{3}{4}$ of a yard, how many steps will he take in 3 miles?

(4) Reduce 5813456 lbs. to tons; and find how many grains of gold are contained in 4 lbs. 11 oz. 16 dwts. 22 grs.

(5) A person's weekly income is £7, and his quarterly expenditure is £64 5s.; how much will he have saved at the end of 4 years, supposing a year to consist of 52 weeks?

(6) Find the value of 319 cwt. 3 qrs. 16 lbs., at £2 12s. 6d. per cwt.

(7) If the value of a rupee be 1s. $11\frac{1}{2}$ d., how many rupees are there in £88 4s. $5\frac{1}{2}$ d.?

(8) At the International Exhibition, £2857 15s. was received in one day by shilling admissions; how many people must be admitted by payment, on a half-crown day, to make up the same amount?

(9) Find the value of 25 tons 3 cwt. 14 lbs. of gunpowder, at £73 6s. 8d. per ton.

(10) If 3 cwt. 3 qrs. 12 lbs. cost £9, what is the price of 6 lbs.?

(11) A bankrupt's debts amount to £4586 8s., and his effects to 3822 guineas: how much will his creditors receive in the pound?

(12) A railway train travels $\frac{1}{4}$ of a mile in 18 seconds; how many miles an hour does it travel at this rate?

(13) A person, after paying 7d. in the £ for income-tax on his income, has £1632 18s. 10d. remaining; what had he at first?

(14) If $35\frac{1}{2}$ lbs. of sugar cost £1 2s. $2\frac{1}{2}d.$, how much will 2 cwt. 51 lbs. cost?

(15) If $\frac{3}{4}$ of an estate be worth £450, what is the worth of $\frac{1}{2}$ of the estate?

(16) Multiply $\frac{2}{7}$ of $\frac{5}{8}$ of $8\frac{1}{2}$ by $\frac{3}{5}$ of $\frac{7}{18}$ of 15; and divide $\frac{3}{11}$ of $27\frac{1}{2}$ by $\frac{3}{10}$ of $21\frac{1}{2}$.

(17) Divide .086457 by .00179, and .032054 by .682.

(18) Extract the square root of

(1) 13277.9529.

(2) 12345.4321.

(3) 8.1.

(4) .00139876.

(5) $1\frac{56}{100}$.

(6) .00015625.

(7) 4.20291001.

(8) 3588.129801.

(9) 3319.48825.

(10) 3915380329. (11) $41\frac{154}{225}$.

(19) Divide ($\frac{17}{20} + \frac{11}{12} + \frac{7}{10} + \frac{4}{5}$) by ($\frac{17}{20} - \frac{11}{12} + \frac{7}{10} - \frac{4}{5}$).

(20) Reduce 1s. $1\frac{1}{2}d.$ to the decimal of a pound. Add together 1.3625 of £1, .75 of 13s. 4d., and .6 of £20.

(21) Multiply 16.02 by .0007, and divide .0006594 by .0021.

(22) Express $\frac{1\frac{3}{4} + 2\frac{5}{8}}{5\frac{1}{2} + 4\frac{1}{8}}$ as a simple fraction; and multiply $\frac{5}{8}$ of $2\frac{1}{4}$ by $\frac{3}{8}$ of $\frac{16}{3}$.

(23) Find the value of .046875 of a ton; reduce 1s. $3\frac{3}{4}d.$ to the decimal of a guinea, and half-a-guinea to the decimal of £2 12s. 6d.

(24) Express 12s. $6\frac{3}{4}d.$ and £4 12s. $6\frac{3}{4}d.$ each as decimals of a pound sterling.

(25) Reduce $\frac{\frac{2}{3} + \frac{5}{8} + \frac{1}{3} \text{ of } 2\frac{1}{3} + \frac{7}{12}}{\frac{2}{3} - \frac{5}{8} + \frac{7}{9} - \frac{1}{4} \times \frac{7}{8}}$.

(26) Express $\frac{3}{16}$ of .375 of 10 shillings + $\frac{1}{8}$ of half-a-crown - $\frac{3}{4}$ of a shilling as the decimal of a pound.

(27) Divide

(1) .0078125 by .00125.

(2) .000123123 by .0032.

(3) 76.11 by 21.5.

(4) 27.5264 by .0374.

(5) 1350.04728 by 2.831.

(6) .02016 by .0024.

(7) .0088266 by .000235.

(28) Required the sum of $\frac{2}{3}$ of $3\frac{3}{10}$, $\frac{1\frac{1}{2}}{2\frac{5}{8}}$ of 17 and $\frac{3}{8}$ of $5\frac{3}{4}$ of $2\frac{1}{2}$.

(29) What sum of money put out at simple interest for $3\frac{1}{2}$ years, at $4\frac{1}{4}$ per cent., will amount to £748 12s. $0\frac{1}{2}d.$?

(30) Reduce to a simple fraction $\frac{1}{17}$ of $\frac{6\frac{1}{2}}{2\frac{3}{4}}$ of ($\frac{25}{9} + \frac{25}{9}$).

Express $\frac{1}{4}$ of 13s. 4d. as the fraction of £5.

(31) If £11187 10s. be invested in the purchase of land, what income will be derived from the investment at $2\frac{1}{4}$ per cent.?

(32) Divide £750 among 3 persons, so that their shares may be as the numbers 7, 10, 13.

(33) If, with a capital of £500, a tradesman gain £50 in 7 months, in what time will he gain £60 10s., with a capital of £385?

(34) If $\frac{7}{24}$ of the cargo of a ship be worth £714 14s., what is the value of the whole cargo?

(35) If the rent of land in France be 140 francs per hectare, calculate the rent per hectare in English money, 25 francs being equal to 20 shillings, and 100 hectares equal to 247 acres?

(36) If 14 English miles are equal to 11 Irish miles, how many Irish miles are there in 154 English miles?

(37) If 15 pumps, working 8 hours a day, can raise 1260 tons of water in 7 days, how many pumps, working 12 hours a day, will be required to raise 7560 tons of water in 14 days?

(38) A brick is 9 in. long, $4\frac{1}{2}$ in. wide, and 3 in. thick; how many bricks will it require to build a wall 520 yds. 9 in. long, 15 ft. high, and $1\frac{1}{2}$ ft. thick?

(39) A person buys 4 cwt. 3 qrs. 14 lbs. of sugar at £2 16s. 8d. per cwt., and sells it at $8\frac{1}{2}$ d. per lb.; how much does he gain or lose?

(40) If 7 men mow 22 acres in 8 days, working 11 hours a day, in how many days, working 10 hours a day, will 12 men mow 360 acres?

(41) Find the expense of lining, with tin, the whole of a cubical box, one edge of which is 4 ft. 6in., at 1s. 8d. a square yard.

(42) Find the value of 28 cwt. 0 qrs. 14 lbs., at 12s. 2d. per cwt.

(43) A ship with its cargo is worth £21456 8s. 9d.; the value of the ship is £4978; find the value of the cargo.

(44) If 24000 yards of cotton cloth, $1\frac{3}{4}$ yards wide, be worth £400, when the raw cotton is at $4\frac{1}{2}$ d. a pound, what is the value of 36000 yards of cotton cloth, $1\frac{1}{2}$ yards wide, when the raw cotton is at 9d. per pound?

(45) In standard gold, 11 parts out of 12 are pure gold. What weight of alloy is there in 3 oz. 5 dwts. of standard gold?

(46) If the corn of 13 horses for 63 days cost £17 6s. 8d., when corn is 4s. per bushel, how many horses will cost £10 13s. 4d. for corn in 56 days, when corn is at 4s. 6d. per bushel?

(47) What will be the cost of painting the four walls of a room which is 24 ft. 3 in. long, 11 ft. 9 in. broad, and 11 ft. 6 in. high, at 1s. 6d. per sq. ft.?

(48) Reduce $\frac{4\frac{1}{2} - 2\frac{1}{2}}{6\frac{1}{2} - 2\frac{1}{2}}$ to a simple fraction?

(49) Find the simple interest on £8333 6s. 8d. for 5 years, at $3\frac{1}{4}$ per cent. per annum.

(50) A reservoir is 24 ft. 8 in. long, by 12 ft. 9 in. wide; how many cubic ft. of water must be drawn off to make the surface sink 1 ft.?

(51) In how many days will the interest on £4600, at $1\frac{1}{2}\%$ per cent. daily, amount to £18 8s.?

(52) Reduce $\frac{3}{8} + \frac{5}{8} + \frac{1}{16} - 1\frac{1}{8}$ to a single fraction; and convert that fraction into a decimal.

(53) A quantity of matting, 37 ft. 9 in. in length and 7 ft. 6 in. wide, will just cover a room; what width of matting that is $75\frac{1}{2}$ ft. long, will be required to cover the same room?

(54) Find the value of the following to 4 places of decimals:

$$\sqrt{7}, \sqrt[4]{7}, 3 - \sqrt{7}.$$

(55) What sum of money, put out at interest for 9 months, at 4 per cent. per annum, will amount to £193 2s. 6d.?

MISCELLANEOUS EXAMPLES SELECTED FROM THE CIVIL SERVICE REPORTS.

EXERCISE LXVIII.

(1) What number added to $1\frac{7}{10}$, $3\frac{9}{16}$, $2\frac{1}{20}$, $\frac{5}{24}$, will make the sum total 10?

(2) If $\frac{1}{10}$ of $\frac{2}{3}$ of $2\frac{1}{2}$ of 40 lbs. of beef cost $1\frac{3}{20}\%$, how many pounds may be bought for £1 6s. 6d.?

(3) If 3 men can mow 7 acres of grass in 5 days of 9 hours each, in how many days of 8 hours each will 5 men mow 35 acres?

(4) If $2\frac{3}{4}$ lbs. of tea cost 12s. 9d., what will $\frac{3}{16}$ of a lb. cost? (Solve by decimals.)

(5) How many yds. of matting, 4·8 ft. broad, will cover a floor that is 27·3 ft. long and 20·16 ft. broad?

(6) Extract the square root of $5\frac{31}{225}$.

(7) Extract the cube root of 134,217,728.

(8) At what rate per cent. will £1303 6s. 8d. amount to £1884 18s. 11d. in 7 years, at simple interest?

(9) A person who has £1475 in the 3 per Cents. at $75\frac{1}{2}$, transfers it to the 5 per Cents. at $110\frac{3}{4}$; what is the alteration in his income?

(10) Explain the difference between interest and discount, and find the present worth of £1215 due 4 years hence, at $5\frac{3}{8}\%$ per cent.

(11) By selling an article for £9 10s., the seller loses 5 per cent. on his outlay; what would be his loss or gain per cent. if he sold it for £11 17s. 6d.?

(12) If I buy 14 oxen for £157 5s. 10d., and sell 6 of them at £7 4s.

each, for what must the remainder be sold that I may gain 4 per cent. on the whole?

(13) What number added to $1\frac{7}{11}$, $2\frac{7}{18}$, $3\frac{5}{22}$, $\frac{9}{24}$, will make the sum total 10?

(14) If $1\frac{3}{4}$ of $\frac{3}{40}$ of $1\frac{3}{4}$ of a ton is worth £4 10s., what is the value of $\frac{3}{8}$ of it?

(15) If 3 men can mow 14 acres of grass in 5 days of 9 hours each, in how many days of 10 hours each will 5 men mow 35 acres?

(16) If $2\frac{3}{8}$ lbs. of tea cost 9s. 6d., what will $\frac{5}{12}$ of a lb. cost? (Solve by decimals.)

(17) How many yards of matting 7·3 ft. broad will cover a floor that is 27·3 ft. long and 10·083 broad?

(18) Extract the square root of $4\frac{213}{289}$.

(19) Extract the cube root of 51478848.

(20) At what rate per cent. will £1303 6s. 8d. amount to £1687 14s. 10d. in 10 years, at simple interest?

(21) A person invests £9075 in the 3 per Cents. at $90\frac{3}{4}$, and on their rising to 91 transfers it to the $3\frac{3}{4}$ per Cents. at $93\frac{1}{2}$; how is his annual income affected?

(22) If oranges be bought at the rate of 20 for a shilling, how many should be sold for £2 8s., in order to gain 40 per cent. upon the outlay?

(23) Explain the difference between interest and discount, and find the true present worth of £553 15s. due 2 years hence, at $5\frac{3}{8}$ per cent.

(24) A person sells out of the 3 per Cents. at 98, and invests his money in railway 5 per cent. stock at par; find how much per cent. his income is increased or diminished.

(25) What number added to $3\frac{3}{8}$, $1\frac{9}{20}$, $2\frac{7}{12}$, $1\frac{8}{15}$ will make the sum total 12?

(26) If $\frac{1}{143}$ of $3\frac{3}{8}$ of $\frac{7}{8}$ of $5\frac{1}{2}$ of 22 lbs. of sugar cost $8\frac{1}{4}$ d., how much will 1 ton 11 cwt. 3 qrs. cost?

(27) If I pay 2s. for 14 lbs. of bread when corn is worth 6s. per bushel, what must I pay for $31\frac{1}{2}$ lbs. when corn is at 4s. the bushel?

(28) If $3\frac{3}{8}$ lbs. of tea cost 15s. 2d., how many lbs. can I buy for £4 3s. $10\frac{1}{2}$ d.? (Solve by decimals.)

(29) A room is 42 ft. long, 28 ft. broad, and 12 ft. high; what will be the cost of covering the walls with a paper 2 ft. 3 in. wide, at 9d. per yard?

(30) Extract the square root of $33\frac{144}{289}$.

(31) Extract the cube root of 12167.

(32) In what time will £527 10s. amount to £602 13s. $4\frac{1}{2}$ d., at $4\frac{3}{4}$ per cent. simple interest?

(33) If the $3\frac{3}{4}$ per Cents. be at 91, how much must I invest in them in

order to have a yearly income of £932 after paying 7*d.* in the pound income tax?

(34) Explain the difference between interest and discount, and find the present worth of £2674 6*s.* due 3 years hence, at $4\frac{3}{4}$ per cent.

(35) A grocer buys 3 cwt. of sugar at 5*d.* per lb., and 7 cwt. at 6 $\frac{1}{2}$ *d.*; he sells 5 $\frac{1}{2}$ cwt. at 5 $\frac{1}{2}$ *d.* per pound; at what rate per pound must he sell the remainder, in order to make 50 per cent. on his whole outlay?

(36) A tobacconist mixes together 80 lbs. of tobacco at 14*d.* per lb. 100 lbs. at 20*d.*, 60 lbs. at 4*s.* 10*d.*, and 20 lbs. at 2*s.* 10*d.* per lb.; what will be the value of 3 oz. of this mixture?

(37) Add together $\frac{5}{13}$ of a pound, $\frac{3}{16}$ of 6*s.* 8*d.*, $\frac{1}{20}$ of a crown, and $\frac{2}{13}$ of a penny.

(38) If $\frac{2}{7}$ of $3\frac{1}{2}$ of $7\frac{3}{4}$ of $\frac{4}{5}$ of 36 lbs. of sugar cost 12*s.* 6 $\frac{1}{2}$ *d.*, how much will 17 tons 17 cwt. cost?

(39) If 12 men can dig a trench 15 yds. long and 4 broad, in 3 days of 12 hours each, in how many days of 9 hours each can 8 men dig a trench 20 yds. long and 8 broad?

(40) What will be the cost of painting the walls of a room, at 1*s.* 7*d.* per sq. yd., the length being 19 ft. 10 $\frac{1}{4}$ in., the breadth 16 ft. 1 $\frac{3}{4}$ in., and the height 10 ft. 3 in.? (Solve by decimals.)

(41) A cistern has 2 pipes, by one of which it may be filled in 20 minutes, and by the other in 25 minutes; it has also a discharging pipe by which it might be emptied in 18 minutes. If all 3 were open together in what time would the cistern be filled?

(42) Extract the square root of 5141 $\frac{95}{256}$.

(43) Extract the cube root of 228099131.

(44) At what rate (simple interest) will £2063 15*s.* amount to £2249 9*s.* 9*d.* in 2 $\frac{1}{2}$ years?

(45) A person invests £9075 in the 3 per Cents. at 90 $\frac{3}{4}$, and on their rising to 91, transfers it to the 3 $\frac{1}{2}$ per Cents. at 97 $\frac{1}{2}$; what increase does he make thereby in his annual income?

(46) A person buys teas at 3*s.* and 4*s.* the lb., and mixes them in the proportion of 4 to 7; what will he gain per cent. by selling the mixture at 4*s.* 2*d.* per lb.?

(47) The population of 5 parishes being 1236, 452, 364, 516, and 3430 respectively, find what the population of a sixth parish must be in order that the average population of the six may be 1256 $\frac{5}{6}$.

(48) A person has $\frac{1}{3}$ of a ship, worth £3484, which is insured for 91 $\frac{3}{4}$ per cent. of its real value; what would he lose in case of the ship being lost?

(49) The populations of 3 towns, in the year 1841 were 21326, 42324, and 6706; and in the year 1851 it was found that the first 2 had

increased 12 and 10 per cent. respectively, and the last decreased 18 per cent.: find the average population of the 3 towns in the year 1851.

(50) If a person sells 22 articles for the same money which he paid for 36, what does he gain per cent. on his outlay?

(51) By selling tea at 5s. 4d. a pound, a grocer clears $\frac{1}{8}$ of his outlay; he then raises the price to 6s. 2d.; what does he clear per cent. upon his outlay, at the latter price?

(52) A person sells out of the 3 per Cents. at 96, and invests his money in railway 5 per cent. stock at £106 13s. 4d.; find how much per cent. his income is increased.

(53) Find the average of 13, 27, 0, 46, 72, 86, and express the fractional part decimally.

(54) The populations of 3 towns in the year 1841, were 20325, 41304, and 6117; and in the year 1851 they had increased respectively 9, 10, and 12 per cent.: find the average population of the 3 towns in 1851.

(55) If goods which were bought at £2 5s. 10d. per cwt. be sold at £2 11s. 4d., what is the gain per cent.?

(56) What is the premium upon a policy of assurance for £6417 14s. 2d., at £2 12s. per cent.?

(57) If, by selling an article at £1 1s. 9d. a pound, I gain 16 per cent. on my outlay, what was its prime cost?

(58) A grocer buys 5 cwt. of sugar at 3d. per lb., and 9 cwt. at $4\frac{1}{2}$ d.; he sells $6\frac{1}{2}$ cwt. at 4d. per lb.; at what rate per lb. must he sell the remainder in order to make 50 per cent. on his whole outlay?

(59) When the 3 per Cents. are at $91\frac{3}{4}$, find how much can be bought for £540, allowing for commission $\frac{1}{8}$ per cent. upon the stock bought.

(60) A person sells out of the 3 per Cents. at 96, and invests his money in railway 5 per cent. stock at par; find how much per cent. his income is increased.

(61) Find the average of 13, 27, 0, 32, 106, 86, and express the fractional part decimally.

(62) The populations of 3 towns, in the year 1841, were 20325, 42405, and 1423; and in the year 1851 they had increased respectively 9, 10, and 12 per cent.: find the average population of the 3 towns in 1851.

(63) If goods which were bought at £2 5s. 10d. per cwt., be sold at £2 14s. 1d., what is the gain per cent.?

(64) What is the premium on a policy of insurance for £9626 11s. 3d. at £2 12s. per cent.?

(65) If by selling an article at 19s. 3d. a pound, I gain 12 per cent. on my outlay, what was its prime cost?

(66) A grocer buys 3 cwt. of sugar at 5d. per pound, and 7 cwt. at

$6\frac{1}{2}d$; he sells $5\frac{1}{2}$ cwt. at $5\frac{1}{2}d$. per lb.; at what rate per lb. must he sell the remainder in order to make 15 per cent. on his whole outlay?

(67) When the 3 per Cents. are at $89\frac{3}{4}$, how much can be bought for £540, allowing for commission $\frac{1}{8}$ per cent. upon the stock bought?

(68) A person sells out of the $3\frac{1}{2}$ per Cents. at 98, and invests his money in railway $4\frac{1}{2}$ per cent. stock at par; find how much per cent. his income is increased.

(69) Reduce $\cdot 601243$ to a vulgar fraction in its lowest terms.

(70) Add $\frac{4}{5}$ of $\frac{3}{8}$ of $4\frac{5}{16}$ of a furlong to $\cdot 05$ of $\cdot 06$ of a mile.

(71) Extract the square root of 13104400.

(72) Extract the cube root of 586376253.

(73) Two persons have each a capital of £12000; one invests it in the 3 per cent. Consols at $90\frac{5}{8}$, the other in railway shares, paying 5 per cent. at $103\frac{3}{4}$; find by how much the income of one exceeds that of the other.

(74) If when wheat is 60s. a quarter the sixpenny loaf weighs 4 lbs., how much should be paid for 25 lbs. of bread when wheat is 40s. a quarter?

(75) Find the cost of papering a room 16 ft. long, 11 ft. wide, and 10 ft. high, with paper 30 in. broad, at $7\frac{1}{2}d$. a yard.

(76) Multiply by the method of duodecimals, 7 ft. 5 in. 8 parts, by 9 ft. 4 in. 11 parts. Express the result obtained in the last question in square inches and a fraction of a square inch.

(77) The expense attending the production of a book, the retail price of which is 7s. 6d., is 2s. $4\frac{1}{2}d$. per copy. The publisher allows the booksellers 25 per cent. on the retail price, and gives 13 copies to the doz.; 3900 copies are printed and sold; the author is to have half the profits: how much will he receive?

(78) Extract the cube root of 408518488.

(79) If 7 men can mow 84 acres in 12 days of $8\frac{1}{4}$ hours each, how many can be mown by 30 men in 11 days of $7\frac{1}{2}$ hours each?

(80) A person sells £6000, 3 per cent. Consols, at $92\frac{1}{4}$, and invests this sum in railway stock paying $5\frac{1}{2}$ per cent. at $103\frac{1}{8}$. Find how his income is affected (neglecting fractions of a penny).

(81) Multiply by the method of duodecimals 2 ft. 7 in. 11 parts, by 3 ft. 5 in. 7 parts, and explain clearly each term of the result.

(82) Reduce $\cdot 26153846$ to a vulgar fraction in its lowest terms.

(83) If by selling goods for £272 I lose 15 per cent., how much per cent. should I have lost or gained if I had sold them for 320 guineas?

(84) Supposing that in England gunpowder is made of 75 parts of nitre, 10 of sulphur and 15 of charcoal; in France of 77 of nitre, 9 of

sulphur, and 14 of charcoal; if a ton of each be mixed, what weight of nitre, sulphur, and charcoal, will there be in the compound?

(85) By a reduction of the interest on exchequer bills from $2\frac{1}{2}\%$ to $1\frac{1}{2}\%$ per cent. per day, a person loses at the rate of £152 7s. 9d. per annum, what amount of exchequer bills does he hold?

(86) Find the average of $17\frac{1}{2}$, $25\frac{1}{2}$, $96\frac{3}{8}$, 10, 0, $42\frac{3}{4}$, 56; and express the fractional part decimally.

(87) In a certain office there is 1 person receiving £2000, 2 who receive £1100 each, 6 who receive £400, 12 who receive £200 each; what is the average income of the persons employed in the office?

(88) A ship valued at £14500 is insured at £3 10s. per cent., and her cargo, valued at £32,000, is insured at £5 per cent. Find the whole cost of insurance.

(89) An army lost 18 per cent. of its strength by disease and desertion, and then lost 14 per cent. of the remainder in battle; the number then remaining was 84624; of how many did the army originally consist?

(90) A person sells £5000 Consols at $94\frac{1}{8}$, and on their rising he sells £5000 more at $95\frac{5}{8}$; on their again rising he buys back the whole £10,000 at 96: what does he lose on the transaction?

(91) The present prices of the 3 per cent. Consols and Midland Railway stock paying $5\frac{1}{4}\%$ are respectively $95\frac{3}{8}$ and $108\frac{1}{2}$. Compare the rates of interest which investments in these stocks would give.

(92) In 1841 the population of great Britain was 21,476,000, and that of Ireland was 7,310,000. In 1851 the former had increased 8.45 per cent., and the latter had decreased 12.5 per cent. Find the increase per cent. in the population of the whole kingdom.

(93) A person buys coffee at £5 12s. 6d. per cwt., and chicory at £2 5s. 5d., and mixes them in the proportion of 2 of chicory to 5 of coffee. He retails the mixture at 1s. 3d. per lb.; what is his gain per cent.?

(94) If by selling wine at 15s. a gallon I lose 10 per cent., at what price must I sell it to gain 15 per cent.?

(95) Find the cube root of 194104539.

(96) Multiply .0021 by 48.026.

(97) The contents of a cistern is the sum of two cubes whose edges are 10 in. and 2 in.; and the area of its base is the difference of two squares whose sides are $1\frac{1}{2}$ and $1\frac{3}{8}$ ft. Find its depth.

(98) If a man rows 10 miles in $2\frac{1}{2}$ hours against a stream, the rate of which is 3 miles an hour, how long would he be in rowing 5 miles with the stream?

(99) What must be the rate of interest in order that the discount on £1936 18s. payable at the end of 3 years may be £207 10s. 6d.?

(100) If 48 pioneers in 5 days of $12\frac{1}{2}$ hrs. long, can dig a trench 139·75 yds. long, $4\frac{1}{2}$ yds. wide, and $2\frac{1}{2}$ yds. deep, how many hours per day must 90 pioneers work during 42 days, in order to dig a trench $4910\frac{1}{16}$ yds. long, $4\frac{7}{8}$ yds. wide, and $3\frac{1}{2}$ yds. deep?

(101) If a steamer makes the passage from New York (say 2760 miles) in 9 days 14 hrs., and a train goes from London to Edinburgh (say 405 miles) in 18 hrs. : compare the rates of the steamer and the train.

(102) Find the square root exactly of $2515\frac{994}{361}$.

(103) Extract the cube root of 5·78 to three places of decimals.

(104) Multiply by the method of duodecimals 3 ft. 1 in. 11 parts, by 2 ft. 6 in. 7 parts, and the product by 1 ft. 7 in.

(105) Express the result of the last question in cubic feet, cubic inches, and a fraction of a cubic inch.

(106) Divide 4·03 by ·1407.

(107) Find the average of $21\frac{3}{5}$, $73\frac{4}{5}$, 0, 3·065, 82, $17\frac{3}{50}$, $5\frac{1}{4}$, $9\frac{5}{12}$; express the fractional part decimally.

(108) A person sells as many 3 per cent. Consols at $98\frac{5}{8}$ as produce £2,000, and invests this sum in railway stock paying $4\frac{1}{2}$ per cent. at $93\frac{3}{4}$. How is his income affected?

(109) Find the true discount on £512 15s. 3d. due 52 days hence, at $2\frac{1}{2}$ d. per cent. a day.

(110) If 5 men can perform a piece of work in 12 days of 10 hrs. each, how many men will perform a piece of work four times as large in a fifth part of the time, if they work the same number of hours in the day, supposing that 2 of the second set can do as much work in an hour as three of the first set?

(111) A canal 10 miles long is 8 yds. wide at the top, 6 yds. wide at the bottom, and 5 ft. deep. How soon would the excavation of it be completed by 800 men, each removing on an average 15 cub. yds. per day?

(112) The rate of a clock is ·0375 per cent. too fast. How much will the clock gain in a week?

(113) A vessel whose speed was $9\frac{1}{2}$ miles per hour, started at 8 o'clock to go a distance of 74 miles. A second vessel, whose speed was to that of the first as 8 to 5, starting from the same place, arrived 5 minutes before the first. When did the second vessel start?

(114) At a siege it was found that a certain length of trench could be dug by the soldiers and navvies in 4 days, but that when only half the navvies were present it required 7 days to dig the same length of trench. What proportion of the work was done by the soldiers?

(115) Find the average of $13\frac{1}{2}$, 21, $7\frac{3}{4}$, ·0023, $3\frac{1}{8}$, 0, $106\frac{1}{2}$, and $57\frac{7}{30}$; express the fractional part decimally.

(116) If by selling wine at 15s. a gallon I lose 6 per cent., at what price must I sell it to gain $17\frac{1}{2}$ per cent.?

(117) Of 32 selected candidates for the East Indian Civil Service in 1859, 3 were above 20 years of age when they went to India, 4 above 21, 12 above 22 and 23 respectively, and 1 above 24. From these data find what is the average age at which the men went to India.

(118) A merchant has teas worth 4s. 6d. and 3s. 6d. per lb. respectively, which he mixes in the proportion of 3 lbs. of the former to 2 of the latter, and sells the mixture at 4s. 4d. per lb.; what does he gain or lose per cent.?

(119) Between the years 1841 and 1851 the population of England increased 14.2 per cent. In the latter year it was 21,121,290; what was it in the former year?

(120) A person invests £5460 in the 3 per Cents. at 91; he sells out £2000 stock when they have risen to $93\frac{1}{2}$, and the remainder when they have fallen to 85; he then invests the produce in $4\frac{1}{2}$ per Cents. at 102; what is the difference in his income?

(121) What must be the market value of 6 per cent. stock, in order that, after deducting the income tax of 10d. in the pound, it may yield $6\frac{1}{2}$ per cent. interest?

(122) If the Roman Catholics are 3 to 1 of the population of Ireland, and the Protestant Dissenters bear the proportion of 2 to 3 to the members of the Established Church, find the proportion per cent. which the Protestant Dissenters bear to the Roman Catholics.

(123) When a $3\frac{1}{2}$ per cent. stock is at 93, find what price a $4\frac{1}{2}$ per cent. stock must bear, that an investment may be made with equal advantage in either stock.

(124) A person sells Midland stock, paying $6\frac{1}{2}$ per cent., at $128\frac{1}{2}$, and invests in Great Western stock, paying 3 per cent., at $72\frac{1}{2}$. By how much per cent. will the interest of his investment be altered?

(125) A person invests £5000 in the new 6 per cent. Turkish loan, issued at 68 per cent., at $2\frac{1}{2}$ premium; how much stock will he have, and what rate of interest will the investment give?

(126) What must be the market value of 3 per cent. stock, in order that, after deducting an income tax of 10d. in the pound, it may yield $3\frac{1}{2}$ per cent. interest?

(127) What is meant by the par of exchange between two countries? When is the exchange said to be against a country? Explain briefly why the course of exchange between two countries varies.

SPECIMENS OF EXERCISES IN ARITHMETIC.

ELEVENTH CIVIL SERVICE REPORT, 1866.

Six similar columns given for the test examination, and twelve for the competitive.

Time allowed, half an hour.

EXERCISE LXIX.

	£	s.	d.		£	s.	d.
(1)	810769	2	2	(2)	25672	3	4
	133879	1	7		19109	19	10
	86631	7	7		273144	9	9
	536408	13	10		627412	3	7
	432219	6	2		961403	5	5
	423925	4	11		935642	1	8
	127433	9	5		418203	2	3
	47983	8	2		673159	0	1
	82163	9	10		156917	11	9
	859276	3	8		16027	3	7
	177119	1	6		181528	3	6
	879	6	1		34232	1	11
	94712	3	3		99374	5	7
	147230	3	7		91467	1	3
	264103	7	7		98278	17	6
	426409	12	8		538097	1	2

(C.) INCLUDING REDUCTION, RULE OF THREE, AND PRACTICE.

Time allowed, one hour and a quarter.

You are requested to write your name at the top of each of your papers; to put the number to each question; to send up the working as well as the answers; and to send up your work on complete sheets of paper, not on scraps which are apt to be lost. These instructions apply to every paper.

EXERCISE LXX.

- (1) In 3,660,607 grains of gold, how many lbs., oz., &c.?
- (2) If 3 cwt. 69 lbs. cost £14 3s. 6d., how much may be bought for £23 12s. 6d.?
- (3) Find (by Practice) the cost of 3 oz. 16 dwts. 15 grs. of gold, at £2 10s. per oz.
- (4) Reduce 4A. 3R. 16P. to sq. ft.
- (5) If the net income of an estate, after paying all taxes, be £267 7s. 6d., and the gross income is £285 4s., how much in the pound do the taxes amount to?
- (6) Find (by Practice) the price of 6 cwt. 3 qrs. 14 lbs., at £2 5s. 6d. per cwt.
- (7) In 4433007 seconds, how many weeks, days, &c.?
- (8) What is the income of a person who loses £84 7s. 6d. a year by an increase of the income tax from 7d. to 9d. in the pound?
- (9) Find (by Practice) the rent of 5A. 1R. 13 perches, at 80s. per acre.
- (10) In 1,000,000 cubic in., how many cubic yds. and ft.?
- (11) If 7 bush. 2 pks. cost £3 5s. 5d., how much will a bushel and a half cost?
- (12) Find (by Practice) the wages of a man for 3 wks. 2 dys. 11 hrs., at 36s. a week, reckoning 6 days to a week, and 12 hours to a day.

(D.) INCLUDING VULGAR AND DECIMAL FRACTIONS.

- (a.) Used in preliminary test examinations, and others which are not competitive.

Time allowed, three hours.

N.B.—You are particularly recommended to answer the questions in the order in which they are set; not omitting any one unless you are unable to do it.

EXERCISE LXXI.

- (1) In 4005201 grs. Troy, how many lbs., oz., &c.?
- (2) If $2\frac{1}{2}$ tons of coals cost £3 2s. 6d., what would $1\frac{1}{2}$ cwt. cost?
- (3) Find (by Practice) the price of 3 qrs. 2 bush. 1 gal. of corn, at £2 13s. 4d. per qr.
- (4) Find the simple interest on £333 10s. for 20 yrs., at $3\frac{1}{4}$ per cent. per annum.

- (5) Add together $\frac{1}{5}$, $\frac{7}{32}$, $\frac{3}{16}$, and $\frac{1}{2}$. (6) Subtract $\frac{25}{27}$ from $2\frac{1}{3}$.
 (7) Multiply $\frac{2}{15}$ by $3\frac{9}{17}$. (8) Divide $\frac{7}{28}$ by $5\frac{1}{2}$.
-

- (9) Add together 407·330719, ·000093, ·02, ·400, and ·005.
 (10) Subtract 3·070101 from 37·005.
 (11) Multiply 7840·6 by 20·471.
 (12) Divide 7·012 by 61·25 to 4 places of decimals.
 (13) Find the value of 2·003125 of £8.
-

- (14) In 4533206 in., how many mls., fur., pla., &c. ?
 (15) If 9 men can build a wall 48 ft. long and 24 ft. high in 5 days, what will be the length of a wall built by them in the same time, 8 ft. in height ?
 (16) Find (by Practice) the price of 7 oz. 13 dwts. 15 grs. of gold, at £3 10s. per oz.
 (17) Find the amount of £10 in 4 yrs., at $4\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).
-

- (18) Add together $\frac{5}{9}$, $\frac{500}{33}$, and $\frac{13}{330}$. (19) Subtract $\frac{111}{40}$ from $3\frac{121}{330}$.
 (20) Multiply $\frac{53}{84}$ by $\frac{105}{1572}$. (21) Divide $3\frac{4}{7}$ by $2\frac{5}{12}$.
-

- (22) Add together ·50145, ·00704, 4·00005, 8000·2 and ·000945.
 (23) Subtract ·44006 from 12·013.
 (24) Multiply ·17034 by 8572.
 (25) Divide 5·008 by ·049 to 3 places of decimals.
 (26) What decimal of a pound Troy is $\frac{2}{3}$ of a dwt. ?
-

- (27) Reduce 1A. 3R. 5P. to sq. ft.
 (28) How much land, of the yearly value of £2 13s. 4d. per acre, must be given in exchange for 188A. of land, of which the yearly value is £2 10s. per acre ?
 (29) Find (by Practice) the wages of a man for 2 wks. 4 dys 10 hrs., at 36s. a week, reckoning 6 days to a week, and 12 hours to a day.
 (30) In what time will £540 amount to £712 16s., at 4 per cent. ?
-

- (31) Add together 9, $2\frac{3}{4}$, $\frac{211}{27}$, and $\frac{1}{54}$.
 (32) Subtract $2\frac{1}{13}$ from $10\frac{1}{39}$.
 (33) Multiply together $\frac{5}{138}$, $\frac{52}{15}$, and 9.
 (34) Divide $300\frac{2}{3}$ by 15.
-

- (35) Add together 20134, ·1992, ·0050434, ·061, and 1.
- (36) Subtract ·004301 from ·0102.
- (37) Multiply 8892 by ·002453.
- (38) Divide 15483·2 by ·001125.
- (39) Reduce $3\frac{3}{4}$ guineas to the decimal of £2 15s.

Similar papers are used also in competitive examinations. The time allowed then is two hours.

(b.) Used in competitive examinations.

Time allowed, two hours and a half.

EXERCISE LXXII.

- (1) Find the sq. root of 676·208016, and the cube root of 66·923396.
- (2) What do you mean by discount? Find the true discount on £528 15s. due 4 yrs. hence, at $5\frac{1}{2}$ per cent.
- (3) Find the average of $12\frac{13}{22}$, 21, $7\frac{3}{4}$, ·034, $3\frac{1}{8}$, 0, $24\frac{1}{3}$, and $12\frac{7}{20}$; express the fractional part decimally.
- (4) If by selling goods for £136 I lose 16 per cent., how much per cent. should I have lost or gained if I had sold them for 160 guineas?
- (5) Add together $\frac{5}{32}$ of a sq. mile, $\frac{7}{10}$ of an acre, and $\frac{5}{8}$ of a rood, giving the result in acres, roods, and perches.
- (6) A person invests £6,534 in the 3 per Cents. at 90, and on their rising to 91 transfers his stock to the $3\frac{1}{2}$ per Cents. at 93 $\frac{1}{2}$; how is his annual income affected?
- (7) The consumption of malt in a country is 7,200,000 qrs., and the duty is 16s. 6d. per quarter. If the duty be reduced 30 per cent., and the consumption then increases 20 per cent., how will the revenue be affected?
- (8) The sidereal year being 365 dys. 6 hrs. 9 min. 9·6 sec.; and the tropical year 365 dys. 5 hrs. 48 min. 49·7 sec.; reduce their difference to the decimal of a sidereal year.
- (9) After a certain number of men had been employed on a piece of work 24 days, and had half finished it, 16 men more were set on, and the remaining half was completed in 16 days; how many men were employed at first, and what was the whole expense of the work at 1s. 6d. a day per man?
- (10) Multiply 13 ft. 7 in. by 9 ft. 3 in., and the product by 2 ft. 5 in.; and express the result in cubic ft., cubic in., and the fractional part of a cubic in.

(11) A room is 34 ft. 8 in. long, 13 ft. 6 in. wide, and 10 ft. 9 in. high. Find the cost of papering it with paper 1 ft. 10 in. wide, at 6*d.* per yd.; and of carpeting it with carpet $\frac{3}{4}$ yd. wide, at 3*s.* 4 $\frac{1}{2}$ *d.* per yd.

(12) Reduce $\frac{5 \cdot 1183}{\cdot 0141}$ of 22·2 of ·09 of ·234 to a vulgar fraction in its lowest term.

OXFORD LOCAL EXAMINATION.

May 29, 1866, from 10 A.M. to 12.

ARITHMETIC (*Juniors*).

(N.B.—Every candidate is required to satisfy the examiners in this paper. Attention should be paid to spelling and handwriting.

No credit will be given for any answer, the full working of which is not shown.)

EXERCISE LXXIII.

(1) Subtract two thousand and fifty from forty-one thousand and thirty-three; then to the remainder add sixteen thousand five hundred and seventy-two; and express the result in words.

(2) Multiply 3003 by 79000. Divide 10897080 by 120, and 51488703 by 567.

(3) Find the sum of £200 1*s.* 2 $\frac{1}{2}$ *d.*, £23 5*s.* 1 $\frac{3}{4}$ *d.*, £195 9*s.* 3 $\frac{1}{2}$ *d.*, £8 10*s.* 0 $\frac{1}{2}$ *d.*, and £127 2*s.* 5*d.*

(4) Subtract £21 1*s.* 11 $\frac{3}{4}$ *d.* from £25 16*s.* 4*d.*

(5) Write out the table of Troy weight.

(6) Multiply 2 dwts. 2 grs. by 101; and divide 10 tons 8 cwt. 3 qrs. 11 lbs. 12 oz. 15 drs. by 69

(7) How many days are there altogether in the months of February, March, April, May, June, and July, in leap year?

(8) Find the number of cubic inches in 1 c. yd. 24 c. ft. 760 c. in.

(9) What is the price of beef per lb. when 4 cwt. may be bought for 16 guineas?

(10) A person rides a distance of 78 miles in 13 hours; how long would it take him, travelling at the same rate, to accomplish a journey of 60 miles?

May 30th, 1866, from 2 to 5 P.M.

ARITHMETIC (*Juniors*) HIGHER PAPER.

EXERCISE LXXIV.

(1) If 53 chests of tea, each weighing 3 qrs. 19 lbs., cost £749 12s. 3d., what is the cost of 17 lbs.?

(2) Find the simplest form of the expression

$$\frac{1\frac{4}{17} \times 6\frac{4}{5}}{3\frac{2}{5} - 1\frac{2}{25}} + \frac{3}{11} \text{ of } (2\frac{3}{4} - \frac{3}{4}) - \frac{1\frac{3}{8}}{12}.$$

(3) Multiply 1·00025 by 2400; divide 3075 by ·125; and find the value of $\cdot 1590 \times \cdot 472 + 2\cdot 7$.

(4) Reduce $\frac{3}{8}$ of 4 oz. 19 dwts. to the decimal of $2\frac{3}{4}$ of 16 dwts. 21 grs.

(5) If the interest on £125 for 3 years be £13 2s. 6d., what will be the interest on £200 for 5 years at the same rate (simple interest)?

(6) What is the rent, at £1 13s. per acre, of a rectangular field, of which the length is 1 fur. 20p., and the breadth 10p. 1 yd.?

May 29th, 1866, from 10 A.M. to 12.

ARITHMETIC (*Seniors*).

EXERCISE LXXV.

(1) How many grs. Troy are there in a mass of metal weighing 1 cwt. 1 qr. 2 lbs. $11\frac{3}{4}$ oz.?

(2) Divide £21544 14s. $2\frac{1}{2}$ d. by 97.

(3) Find (by Practice) the value of 1 qr. 2 bus. 2 pks. at £29 16s. 6d. a bushel.

(4) Express in their simplest forms:

$$(1) \frac{1992}{1958}, \quad (2) 3\frac{1}{3} + \left\{ \frac{1 - \frac{15}{18}}{\frac{1}{8} - \frac{1}{8}} \right\}.$$

(5) Add together $\frac{7}{16}$ of £5, $\frac{3}{4}$ of £9 13s. $2\frac{3}{4}$ d., and $\frac{5}{12}$ of 2s. 6d.

(6) Divide 1215013·8 by 2·023, and ·000072072 by ·000012.

(7) Reduce 4 oz. 7 dwts. 12 grs. to the fraction of 5 oz. Troy, and 14s. $7\frac{1}{2}$ d. to the decimal of £5.

(8) Find the fraction corresponding to 1·01, and divide 27·36 by 3·109.

(9) If a cubic ft. of marble weigh 2·716 times as much as a cubic ft. of water, find the weight of a block of marble 9 ft. 6 in. long, 2 ft. thick, supposing a cubic ft. of water to weigh 1000 oz.

(10) It is found that 1296 bricks (the exposed surface of each brick measuring $9\frac{1}{2}$ in. by $4\frac{1}{2}$ in.) have been employed in paving a certain

court-yard; how many tiles 6 in. square would be required for a pavement one-ninth of the size?

(11) Define present value and discount. Which is the better stock for investment: the $3\frac{1}{4}$ per Cents. at $92\frac{5}{8}$, or the $3\frac{1}{2}$ per Cents. at par?

CAMBRIDGE LOCAL EXAMINATION.

December 12th, 1865, 9 to 11 A.M.

ARITHMETIC, PART I. (*Juniors*).

(N.B.—Every candidate is required to satisfy the examiners in the first part of this paper. The whole working of the sums is to be sent up; answers without the working will not do.)

EXERCISE LXXVI.

(1) Add up	1 2 3 4 5
	6 7 8 9 1
	2 3 4 5 6
	7 8 9 1 2
	3 4 5 6 7
	8 9 1 2 3
	4 5 6 7 8
	<u>9 1 2 3 4</u>

and subtract two hundred and twenty thousand and seventy-six from the sum.

(2) Multiply 2468 by 3057, and divide the product by 3702.

(3) Add together $\frac{1}{8}$ and $\frac{2}{3}$; also subtract $\frac{1}{8}$ from $\frac{2}{3}$; and divide the sum by the difference.

(4) Find the cost of 27 tons of coal at 17s. 9d. per ton; also of 12 tons at £1 2s. 6d. per ton, and of 11 tons at 19s. 4d. per ton, and add up the whole cost.

(5) Find (by Practice) the cost of 65 rods of park paling at £2 7s. per rod.

(6) If 18 gallons of beer cost £1 1s., what is the cost of 11 pints?

PART II.

(7) Divide 10·8528 by 1·02; and express the quotient as a vulgar fraction.

(8) A square field contains 3A. 1R. 13P. $5\frac{3}{4}$ yds.; find the length of each side.

(9) Find the present worth of £325, due 12 months hence, at $4\frac{1}{2}$ per cent. per annum.

(10) The produce of a field of wheat yielding 4 qrs. per acre is worth £148, when wheat is at £3 per qr.; what will the produce of the same field be worth when the yield is 5 qrs. per acre, and wheat is at 50s. per qr.?

(11) 3 partners invest £3000, £1200, and £2000 respectively, in a common business, and at the end of a year the profits are £744; what will be the share of each partner?

(12) A man spends every year one-tenth of his income, and invests the rest in annuities, at the rate of £90 for every annuity of £3; supposing his income £1000 a year to begin with, what will it be at the end of 4 years?

(13) Find the value of a balk of timber 39 ft. 6 in. long and 3 ft. 7 in. thick each way, at 2s. 6d. per cub. ft.

December 12th, 1865, 9 to 11 A.M.

ARITHMETIC, PART I. (*Seniors*).

EXERCISE LXXVII.

(1) Multiply 3879 by 42.

(2) Show that the sum of 81459 and 54306 is equal to 5 times their difference.

(3) Show that there are the same number of farthings in £59 12s. $1\frac{3}{4}$ d. as there are pounds in 25 tons 10 cwt. 3 qrs. 19 lbs.

(4) A grocer buys 572 lbs. of tea at 2s. $2\frac{1}{4}$ d. a lb., and sells them at 2s. 6d. a lb.; what does he gain by the transaction?

(5) Add together $\frac{2}{3}$ of $\frac{1}{7}$ of $8\frac{3}{4}$ and $\frac{1}{4}$ of $\frac{2}{3}$.

(6) Extract the sq. root of 47099.

(7) If 18 yds. of cloth cost £15 10s. 6d., how much will 11 ft. cost?

(8) Find how much 2 cwt. 1 qr. 21 lbs. of pepper will cost at £66 4s. a cwt.

(9) Add together ·412 and ·083, and subtract your result from ·51.

(10) Divide ·00307326 by 3·013.

(11) Assuming that a cubic mètre contains 1000 litres, and that a mètre contains 39·4 in., find the number of cubic in. in a litre.

(12) Add together ·0625 of 2s. 8d. ·2 of 2s. 7½d., and ·8375 of £1, and reduce the result to a decimal of £7.

(13) Find the simple interest of £612 10s. for 6 years, at 3½ per cent.

(14) Explain the principle of the common system of numerical notation. Multiply 102 by 31, giving the reasons for the several steps.

PART II.

(15) What fraction of $\frac{3}{5}$ of £3 19s. 9d. is equal to $\frac{2}{3}$ of £1 2s.?

(16) Find the discount on £237 10s. paid 2 years before it becomes due at 7 per cent. simple interest.

(17) Assuming that an express train runs 40 miles an hour, and an ordinary train 30 miles an hour, and that the express fare is ½d. a mile more than the ordinary; find how much an hour a man's time is worth if it cost him the same to travel by the one as by the other.

(18) A man invests £153 14s. 4d. in the 3½ per Cents. at 92, and £184 12s. 6½d. in the 2½ per Cents. at 85; show that he will receive the same income as he would have received had he invested the whole sum in the 3 per Cents. at 90.

MODE OF CALCULATING INTEREST IN POST OFFICE SAVINGS' BANKS.

As the system of Post Office Savings' Banks has extended so rapidly during the last few years, that there is now scarcely a village of any size in the United Kingdom but what furnishes a certain number of depositors, it may not be out of place to note here the amount of interest allowed by these banks, and the manner in which it is calculated. At present, the rate is £2 10s. per cent. per annum; but it is not improbable that, at some future date, the Government may see fit to grant a more liberal allowance.

(1) 2½ per cent. being exactly ½d. per pound per calendar

month, it is easy to calculate the amount of interest due on any particular sum by allowing a halfpenny for every complete pound which has been deposited for a whole calendar month.

(2) No interest being allowed on sums under £1, or on sums which have not been deposited for one clear calendar month.

Thus, a person depositing £10 on the 28th December, 1864, and closing his account on the 3rd October, 1865, would receive 3s. 9d. for interest, viz :

(A) Interest on £10 for 1 calendar month = 10 halfpence \times 9 (No. of months) = 90 = 45 pence or 3s. 9d.

(B) If from the same account we withdraw £2, on the 2nd August, 1865, the interest due when the account was closed would amount to 3s. 7d., viz.

Interest on £10 for 7 calendar months = 70 halfpence.

" " £8 " 2 " " = 16 "

2) 86

12) 43

3s. 7d.

(3) When deposits and withdrawals are made in the same month, the following rules should be observed in the computation of interest :

When the deposit precedes and is larger than the withdrawal, interest must be allowed on the balance of the previous month (see example C) ; but when the withdrawal is larger than the deposit, the difference between them must be deducted from the balance due the previous month, and the interest computed on the result (see example D). When the withdrawal precedes the deposit, the ordinary course must be pursued (see example B).

(C)

Deposits.				Withdrawals.			
1865	£	s.	d.	1865	£	s.	d.
Jan. 4.	4	0	0	Feb. 5.	2	0	0
June 6.	2	0	0	July 16.	8	0	0
July 7.	10	0	0				
Int.	0	1	10	Bal.	6	1	10
	<u>16</u>	<u>1</u>	<u>10</u>		<u>16</u>	<u>1</u>	<u>10</u>
Bal.	6	1	10				

In this example, interest is allowed on £4 in July, as explained in (3).

(D)

Deposits.				Withdrawals.			
1865	£	s.	d.	1865	£	s.	d.
Mar. 8.	2	0	0	May 2.	1	0	0
June 6.	3	0	0	Aug. 8.	9	0	0
July 4.	1	0	0				
Aug. 2.	6	0	0				
Int.	0	0	9	Bal.	2	0	9
	<u>12</u>	<u>0</u>	<u>9</u>		<u>12</u>	<u>0</u>	<u>9</u>
Bal.	2	0	9				

In this example, interest is allowed on £2 in August, as explained in (3).

EXERCISE LXXVIII.

(1) A depositor pays in £20 10s. on the 19th August, 1865, and closes his account on the 4th November, 1866. What interest should he receive?

(2) A man makes 4 deposits: £10 on the 26th February, 1865, £10 on the 30th March, 1865, £5 on the 20th April, 1865, and £4 on the 22nd November, 1865; what is the amount of his account on the 1st January, 1866?

(3) A man deposits 5s. on the 20th February, 1865, 3s. on the 19th March, 15s. on the 16th April, and £5 5s. on the 19th June, and withdraws 5s. on the 3rd October, and £2 on the 4th December in the same year; what balance is due to him on the 1st January, 1866?

(4) The trustees of a friendly society deposit £1500 on the 25th February, 1865, and withdraw £1000 on the 3rd November, 1865,

and on the 2nd January, 1866, they give notice to close their account ; what is the amount due to them ?

(5) A man deposits 10s. on the last day of every month, beginning on the 31st January, 1863. What will be the balance due to him on the 1st January, 1867, if he withdrew £5 at Christmas, 1866 ?

(6) A person deposits £30 on the 23rd December, 1865, and £30 on the 3rd January, 1866. What will be the balance of his account on the 1st January, 1868, if he withdrew £10 in June, 1867 ?

(7) A traveller makes 3 deposits of £10 each : the first at Brighton, on the 20th July, 1865, the second at Glasgow, on the 17th August 1865, the third at Belfast, on the 28th October, 1865, and withdraws £12 at London, on the 3rd November, 1865. What will be the balance of his account on the 1st January, 1866 ?

ANSWERS

TO

LUPTON'S ARITHMETIC.

LONDON:
LONGMANS, GREEN, AND CO.
1867.

ANSWERS

TO

EXAMPLES.

EXERCISE I.

Four thousand and sixteen. Three hundred and sixty thousand and thirteen. Twenty millions thirteen thousand six hundred and forty-five. Six billions three hundred and forty thousand and five millions seventeen thousand and thirty-four. Four thousand millions seven thousand six hundred and forty-three. Thirty millions and one. Eight trillions one hundred and thirty thousand six hundred and forty billions one thousand seven hundred millions six hundred and thirty-four thousand and one. Ninety millions one hundred and five thousand and three. Seventy-seven millions five thousand and three. Six hundred and seven thousand and thirty-five.

603050. 7003040. 840020. 10004008. 8000001002. 1102070050.
401301. 200008011. 400000510. 70103.

EXERCISE II.

- | | | |
|------------------|------------------|------------------|
| (1) 201192. | (2) 10902590. | (3) 14251814. |
| (4) 9711786. | (5) 18578995. | (6) 154832864. |
| (7) 62523607. | (8) 146071795. | (9) 1788591628. |
| (10) 1604965241. | (11) 2569286034. | (12) 2689134309. |

EXERCISE III.

- | | |
|---------------------------|---------------------------|
| (1) 12211112. | (2) 2244174440220. |
| (3) 2522848716973. | (4) 93751715310998. |
| (5) 4354973319789. | (6) 418969675560764269 |
| (7) 20432125143859947338. | (8) 60091409370679. |
| (9) 37244818289397. | (10) 8070599951547380. |
| (11) 13949675870177998. | (12) 2801416884358187578. |

EXERCISE IV.

- | | | |
|------------------------|----------------------|-----------------------|
| (1) 39898048. | (2) 1637715. | (3) 2175139892. |
| (4) 888888888. | (5) 5526950247. | (6) 4024370231295. |
| (7) 419360787288. | (8) 15215907. | (9) 1316909736. |
| (10) 2264188452998. | (11) 18006542431134. | (12) 474962963344002. |
| (13) 1702755260372808. | | (14) 574504650325. |
| (15) 143161888947. | (16) 536213108705. | (17) 7661423925262. |
| (18) 1781905039614. | (19) 22169054828. | (20) 6119338474170. |

EXERCISE V.

- | | | |
|---------------------|------------------|---------------------|
| (1) 44679128. | (2) 312747928. | (3) 36194372. |
| (4) 5975047 - 4. | (5) 497651 - 5. | (6) 283572101 - 4. |
| (7) 7254200 - 31. | (8) 132694 - 19. | (9) 1310782 - 55. |
| (10) 98117142 - 25. | (11) 551784 - 9. | (12) 64546918 - 47. |
| (13) 925671. | (14) 523475. | (15) 789648. |
| (16) 24561. | (17) 956475. | (18) 1794353. |
| (19) 8297561. | (20) 42587532. | |

EXERCISE VI.

- | | |
|---------------------------------|-------------------------------|
| (1) 1808 farthings. | (2) 8561 halfpence. |
| (3) 35519 farthings. | (4) 1260000 pence. |
| (5) 143027 threepenny pieces. | (6) 39640104 halfpence. |
| (7) 545593515 farthings. | (8) 22518480 farthings. |
| (9) 443155472 fourpenny pieces. | (10) 480000018 farthings. |
| (11) 12384200 pence. | (12) 7844 drams. |
| (13) 14366 drams. | (14) 3680659 drams. |
| (15) 37529 ounces. | (16) 72805374 drams. |
| (17) 314172133518 ounces. | (18) 10052 grains. |
| (19) 32413 grains. | (20) 1012973333180 grains. |
| (21) 135983 grains. | (22) 210933 grains. |
| (23) 30339716 grains. | (24) 6154991396 grains. |
| (25) 8262 feet. | (26) 1611390 inches. |
| (27) 93379083280 feet. | (28) 223715510 square feet. |
| (29) 7686527001 square feet. | (30) 575 pints. |
| (31) 2279 pints. | (32) 1200025517 pints. |
| (33) 259400 cubic inches. | (34) 2505610 cubic inches. |
| (35) 2659 inches. | (36) 30766 inches. |
| (37) 3475559 inches. | (38) 271732 seconds. |
| (39) 410520 hours. | (40) 107291352988816 seconds. |

EXERCISE VII.

- (1) £60 0s. 10 $\frac{3}{4}$ d. (2) £9003 7s. 0 $\frac{3}{4}$ d.
 hlf.-crows d. guineas s. d.
 (3) 15545 7 $\frac{3}{4}$. (4) 1850 13 3 $\frac{1}{4}$.
 (5) £7140 5s. 10 $\frac{1}{2}$ d. (6) £183905171 4s. 4d.
 (7) £296914179 13s. 10d. (8) £625000006 5s.
 guineas s. d. guineas s. d.
 (9) 6999487843 2 6 $\frac{3}{4}$. (10) 157603265 3 1.
 guineas s. d.
 (11) 1416309581 4 0 $\frac{1}{2}$. (12) £3806644695 9s. 2 $\frac{3}{4}$ d.
 guineas s. d.
 (13) £3929863860 6s. 9d. (14) 162933785831 15 0.
 seven-shilling pieces s. d. half-crowns s. d.
 (15) 1349046532 4 10 $\frac{3}{4}$. (16) 31244824 1 8 $\frac{3}{4}$.
 crowns s. d.
 (17) 3287502. (18) 3649128 1 2 $\frac{1}{2}$.
 (19) 556554 cwt. 1 qr. 10 lbs. 11 oz.
 (20) 759765338 tons 16 cwt. 2 qrs. 16 lbs. 6 oz. 1 dr.
 (21) 165174 cwt. 3 qrs. 14 lbs. 15 oz. 11 drs.
 (22) 551146 tons 7 cwt. 2 qrs. 10 lbs.
 (23) 12745 tons 5 cwt. 0 qrs. 7 lbs. 4 oz.
 (24) 13329 tons 14 cwt. 2 qrs. 10 lbs. 4 oz. 15 drs.
 (25) 1029428 qrs. 12 lbs. 14 oz. 10 drs.
 (26) 2182462917309 lbs. 0 oz. 4 drs. 2 scr. 9 grs.
 (27) 1462376 lbs. 8 oz. 19 dwts. 1 gr.
 (28) 159464977 oz. 1 dwt. 17 grs.
 (29) 133407439 lbs. 2 oz. 3 dwts.
 (30) 473661 fur. 3r. 1 yd. 0 ft. 11 in.
 (31) 53686 mls. 7 fur. 34r. 5 yds. 1 ft. 2 in.
 (32) 7400 mls. 7 fur. 26r. 5 yds. 1 ft. 10 in.
 (33) 314599 leagues 1 ml. 6 fur. 26r. 4 yds. 1 ft.
 (34) 6632A. 1R. 1P. 6 yds. 4 ft. 128 in.
 (35) 31640A. 3R. 35P. 11 $\frac{1}{2}$ yds.
 (36) 1555A. 3R. 34P. 9 yds. 8 ft. 41 in.
 (37) 40028846 lds. 2 qrs. 5 bus. 1 pk. 1 gal. 3 qts.
 (38) 4 yrs. 3 mo. 0 wks. 0 dys. 21 hrs. 33 min. 9 sec.
 (39) 501 yrs. 10 mo. 2 wks. 1 dy. 23 hrs. 7 min. 4 sec.
 (40) 33257 yrs. 8 mo. 0 wks. 1 day 13 hrs. 31 min. 8 sec.

EXERCISE VIII.

- (1) £542 2s. 7 $\frac{1}{2}$ d. (2) £1334 7s. 5 $\frac{1}{2}$ d. (3) £1054 17s. 4 $\frac{1}{2}$ d.
 (4) £6759 17s. 3 $\frac{1}{2}$ d. (5) £3466 3s. 4 $\frac{1}{2}$ d. (6) £112590 18s. 1 $\frac{1}{4}$ d.
 (7) £116862 18s. 7d. (8) £89951 3s. 7d. (9) £11065 11s. 8d.

- (10) £13066 16s. 1d. (11) £140677 19s. 8½d. (12) £143240 4s. 11½d.
 (13) £899997 1s. 1¾d. (14) £2826612 15s. 9¼d. (15) £3469061 5s. 3d.
 (16) £3665984 9s. 3d. (17) 39 tons 11 cwt. 2 qrs. 3 lbs. 4 oz. 15 drs.
 (18) 42 tons 9 cwt. 0 qrs. 8 lbs. 15 oz. 14 drs.
 (19) 35 tons 14 cwt. 3 qrs. 17 lbs. 2 oz. 8 drs.
 (20) 48 oz. 3 dwts. 10 grs. (21) 5 lbs. 6 oz. 3 dwts. 13 grs.
 (22) 38 oz. 18 dwts. 19 grs. (23) 47 drs. 0 scr. 16 grs.
 (24) 5 oz. 3 drs. 0 scr. 1 gr. (25) 4 oz. 7 drs. 0 scr. 8 grs.
 (26) 21 qts. 1 pt. 3 gills. (27) 24 qts. 0 pts. 2 gills.
 (28) 29 qts. 1 pt. 2 gills. (29) 112 hrs. 3 min. 5 sec.
 (30) 97 hrs. 41 min. 58 sec. (31) 51 hrs. 0 min. 5 sec.
 (32) 137P. 3 yds. 1 ft. 8 in. (33) 97 mls. 0 fur. 35P. 4 yds. 1 ft.
 (34) 28 fur. 25 yds. 0 ft. 3 in. (35) 54 ells 0 qrs. 2 nls. 1½ in.
 (36) 111 yds. 2 qrs. 3 nls. ¼ in. (37) 171 ells. 3 qrs. 0 nls. ½ in.
 (38) 771 mls. 488A. 0R. 0P. (39) 198 mls. 609A. 1278 yds. 6 ft.
 (40) 2446A. 2513 yds. 8 ft. 4 in.

EXERCISE IX.

- (1) £23 1s. 9d. (2) £1 3s. 10d. (3) £6 9s. 0¾d.
 (4) £7 16s. 1½d. (5) £8 11s. 8¼d. (6) £19 18s. 11¼d.
 (7) £28 1s. 1¼d. (8) £35 19s. 0¾d. (9) £67 14s. 6¾d.
 (10) £84 12s. 0¾d. (11) £89 9s. 0¾d. (12) £100 1s. 7¼d.
 (13) £200 17s. 8¼d. (14) £500 9s. 0¾d. (15) £896 18s. 10¾d.
 (16) £3960 0s. 9¾d. (17) £14188 18s. 10¼d. (18) £8880 18s. 1¾d.
 (19) £87320 15s. 5d. (20) £97854 18s. 7¾d. (21) 1 lb. 10 oz. 13 drs.
 (22) 1 qr. 0 lbs. 10 oz. 14 drs. (23) 4 lbs. 11 oz. 10 drs.
 (24) 0 oz. 6 dwts. 9 grs. (25) 3 oz. 1 dwt. 18 grs.
 (26) 0 lbs. 5 oz. 18 dwts. 23 grs. (27) 0 oz. 1 dr. 1 scr. 18 grs.
 (28) 0 oz. 2 drs. 0 scr. 8 grs. (29) 6 oz. 1 dr. 1 scr.
 (30) 9 yds. 0 ft. 2 in. (31) 10 miles 0 fur. 8P.
 (32) 43 miles 3 fur. 38P. (33) 2 yds. 0 qrs. 2 nls.
 (34) 5 yds. 2 qrs. 3 nls. (35) 9 yds. 1 qr. 2 nls.
 (36) 40A. 0R. 18P. (37) 43A. 1R. 36P.
 (38) 9A. 0R. 30P. (39) 5 qrs. 3 bus. 2 pks.
 (40) 0 bus. 0 pks. 0 gals. 2 qts. (41) 0 gals. 2 qts. 0 pts. 1 gill.
 (42) 65 hrs. 10 min. 48 sec.
 (43) 1 ton 15 cwt. 2 qrs. 26 lbs. 9 oz. 15 drs.
 (44) 1 lb. 9 oz. 15 dwts. 22 grs.
 (45) 2 lbs. 5 oz. 5 drs. 2 scr. 16 grs.
 (46) 1 ml. 1 fur. 36P. 0 yds. 2 ft. 9 in.
 (47) 0 lds. 3 qrs. 5 bus. 2 pks. 1 gal. 3 qts. 0 pts.

ANSWERS TO EXAMPLES.

V

- (48) 2A. 2R. 35P. 3 sq. yds. 8 ft. 127 in.
 (49) 3 yrs. 10 mo. 2 wks. 3 dys. 19 hrs. 55 min. 19 sec.
 (50) 1 cub. yd. 22 ft. 1379 in.

EXERCISE X.

- | | | |
|------------------------|-----------------------|-----------------------|
| (1) £92 4s. 6d. | (2) £117 1s. 0d. | (3) £148 15s. 9½d. |
| (4) £233 16s. 5½d. | (5) £431 15s. 6d. | (6) £631 4s. 4d. |
| (7) £1488 17s. 4¾d. | (8) £2869 0s. 10d. | (9) £3857 12s. 10½d. |
| (10) £4737 5s. 9d. | (11) £7251 11s. 4¾d. | (12) £7537 12s. 7d. |
| (13) £3681 0s. 4d. | (14) £22046 12s. 8d. | (15) £19577 8s. 11¼d. |
| (16) £28594 11s. 10½d. | (17) £17777 14s. 9½d. | (18) £47579 7s. 6d. |
| (19) £54931 19s. 5½d. | (20) £64728 2s. 6d. | (21) £81299 4s. 9d. |
| (22) £106533 5s. 0d. | (23) £871 17s. 6d. | (24) £1674 8s. 1½d. |
| (25) £2949 18s. 6d. | (26) £3667 11s. 6d. | (27) £5051 17s. 9d. |
| (28) £2912 5s. 0d. | (29) £2300 18s. 6d. | (30) £9652 6s. 0d. |
| (31) £2022 10s. 0d. | (32) £5456 14s. 0d. | |
| (33) £7745 12s. 1d. | (34) £11196 10s. 0d. | |
| (35) £15925 4s. 0d. | (36) £24102 10s. 0d. | |

EXERCISE XI.

- | | | |
|------------------------|----------------------|----------------------|
| (1) £36082 0s. 7½d. | (2) £1262 6s. 8d. | (3) £3053 9s. 2d. |
| (4) £6049 13s. 9d. | (5) £10338 13s. 4d. | (6) £17211 11s. 0½d. |
| (7) £99 14s. 8d. | (8) £1938 13s. 2½d. | (9) £231 19s. 4¾d. |
| (10) £5799 13s. 9¾d. | (11) £3019 15s. 6¾d. | (12) £1564 13s. 1¼d. |
| (13) £363008 19s. 0¾d. | (14) £65 7s. 9¾d. | (15) £7448 14s. 7¾d. |
| (16) £2694 10s. 6d. | (17) £139 3s. 1¼d. | (18) £914 17s. 5½d. |

EXERCISE XII.

- (1) 1541 lbs, 1 oz. 15 dwts. 16 grs.
 (2) 10585 lbs. 3 oz. 9 dwts. 8 grs.
 (3) 556 lbs. 10 oz. 13 dwts. 8 grs.
 (4) 6967 lbs. 6 oz. 0 drs. 0 scr. 0 grs.
 (5) 17 lbs. 0 oz. 5 drs. 2 scr. 16 grs.
 (6) 533 lbs. 3 oz. 0 drs. 0 scr.
 (7) 4671 yds. 0 qrs. 0 nls.
 (8) 550 ells 0 qrs. 2 nls. 1¾ in.
 (9) 503 yds. 1 qr. 3 nls. 1½ in.
 (10) 284 yrs. 10 mo. 0 wks. 4 dys.
 (11) 138 yrs. 12 mo. 3 wks. 3 dys. 12 hrs.
 (12) 9 yrs. 4 mo. 1 wk. 4 dys. 16 hrs.
 (13) 4118 tons 1 cwt. 2 qrs. 8 lbs.

- (14) 44 tons 16 cwt. 0 qrs. 22 lbs. 10 oz.
 (15) 7 tons 2 cwt. 2 qrs. 2 lbs. 1 oz. 0 drs.
 (16) 1877 gals. 0 qts. 1 pt. 3 gills.
 (17) 1138 lds. 1 qr. 0 bus. 3 pks.
 (18) 1282 qrs. 4 bus. 0 pks. 0 gals.
 (19) 109888 cub. yds. 21 ft. 423 in.
 (20) 16635 cub. yds. 2 ft. 936 in.
 (21) 11150 cub. yds. 25 ft. 600 in.
 (22) 4142 mls. 2 fur. 27 p. 1 yd. 1 ft. 6 in.
 (23) 992 mls. 1 fur. 27 p. 3 yds. 2 ft. 6 in.
 (24) 14 mls. 6 fur. 17 p. 2 yds. 0 ft. 2 in.
 (25) 1A. 2R. 8P. 11 yds. 2 ft. 108 in.
 (26) 456A. 1R. 26P. $15\frac{3}{4}$ yds.
 (27) 23157A. 1R. 20P.

EXERCISE XIII.

- | | | |
|----------------------------------|----------------------------------|-----------------------------------|
| (1) £16 18s. 9d. | (2) £1680100 19s. 11d. | |
| (3) £176 8s. 11d. | (4) £186 3s. $3\frac{3}{4}$ d. | (5) £117 8s. $6\frac{3}{4}$ d. |
| (6) £8 12s. 11d. | (7) £630 18s. $3\frac{1}{2}$ d. | (8) £558 18s. $8\frac{1}{2}$ d. |
| (9) £7 15s. $9\frac{1}{4}$ d. | (10) £7 1s. 1d. | (11) £3 14s. 9d. |
| (12) £6 8s. 4d. | (13) £24 9s. $0\frac{1}{2}$ d. | (14) £2 19s. $9\frac{1}{4}$ d. |
| (15) £454 10s. $5\frac{1}{4}$ d. | (16) £779 19s. $1\frac{3}{4}$ d. | (17) £4 16s. 9d. |
| (18) £8 7s. 0d. | (19) £10 4s. 7d. | (20) £8 5s. 1d. |
| (21) £5 11s. 3d. | (22) £1280 15s. 3d. | (23) £4 4s. 7d. |
| (24) £2 18s. $9\frac{1}{2}$ d. | (25) £36 0s. $1\frac{3}{4}$ d. | (26) £40 18s. 3d. |
| (27) £57 6s. $2\frac{1}{4}$ d. | (28) £78 9s. $9\frac{1}{2}$ d. | (29) £40 16s. 6d. |
| (30) £70 10s. $6\frac{1}{8}$ d. | (31) £3 2s. $6\frac{1}{2}$ d. | (32) £10 3s. $6\frac{1}{4}$ d. |
| (33) £40 10s. $9\frac{1}{2}$ d. | (34) £60 10s. 6d. | (35) £100 14s. 6d. |
| (36) £500 16s. $6\frac{1}{2}$ d. | (37) £1 6s. $6\frac{1}{4}$ d. | (38) £2 10s. $2\frac{1}{2}$ d. |
| (39) £5 12s. 8d. | (40) £20 10s. 6d. | (41) £329 0s. 2d. |
| (42) £33 12s. $0\frac{1}{2}$ d. | (43) £1299 1s. 3d. | (44) £100 11s. $11\frac{3}{4}$ d. |
| (45) £753 3s. 2d. | (46) £14 2s. $1\frac{1}{4}$ d. | |

EXERCISE XIV.

- | | |
|------------------------------------|---|
| (1) 9 lbs. 11 oz. 5 dwts. | (2) 17 lbs. 2 oz. 19 dwts. |
| (3) 3 tons 13 cwt. 1 qr. 4 lbs. | (4) 7 tons 19 cwt. 3 qrs. 27 lbs. |
| (5) 12 lbs. 7 oz. 5 drs. 2 scr. | (6) 5 lbs. 2 oz. 7 drs. 2 scr. |
| (7) 5 mls. 6 fur. 8P. | (8) 7 yds. 2 ft. 5 in. |
| (9) 21A. 3R. 15P. | (10) 3A. 2R. 19P. |
| (11) 4 yds. 3 qrs. 1 nl. | (12) 3 cub. yds. 8 ft. 171 in. |
| (13) 2 bus. 3 pks. 1 gal. 2 qts. | (14) 3 qrs. 7 bus. 2 pks. 1 gal. 2 qts. |
| (15) 0 months 0 wks. 1 dy. 16 hrs. | (16) 0 months 0 wks. 0 dys. 22 hrs. |

EXERCISE XV.

- | | | |
|--|-------------------|---------------------------------------|
| (1) £1 15s. 0d. | (2) £6 6s. 8d. | (3) £3 13s. 4d. |
| (4) £5 16s. 8d. | (5) £2 12s. 6d. | (6) £12 16s. 0d. |
| (7) £9 7s. 6d. | (8) £42 2s. 6d. | (9) £50 10s. 10d. |
| (10) £70 8s. 6d. | (11) £7 6s. 1½d. | (12) £100 8s. 11d. |
| (13) £3 3s. 2¾d. | (14) £14 2s. 2¼d. | (15) £8 6s. 6½d. |
| (16) £23 11s. 9¾d. | (17) £17 4s. 4¼d. | (18) £12 9s. 2½d. |
| (19) £96 2s. 7d. | (20) £1 6s. 7¼d. | (21) 3 lbs. 7 oz. 15 dwts. |
| (22) 0 tons 17 cwt. 3 qrs. | | |
| (23) 2 mls. 3 fur. 20r. 3 yds. 2 ft. 5 in. | | |
| (24) 1A. 2B. 15P. 6 yds. 7 ft. 26 in. | | |
| (25) 7. | (26) 5. | (27) 6. (28) 17. |

EXERCISE XVI.

- | | | |
|--|--------------------------|--------------------------|
| (1) £480 13s. 4d. | (2) £1 12s. 0d. | (3) £45 17s. 9d. |
| (4) £734 1s. 0d. | (5) £694 15s. 4d. | (6) 2,836,809,240,557. |
| (7) £12 0s. 0d. | (8) £19 0s. 10d. | (9) £316 6s. 3¼d. |
| (10) £434 11s. 10¾d. | (11) £31 10s. 0½d. | (12) Loss £231 18s. 10d. |
| (13) £206080. | (14) £24 11s. 0d. | (15) £191 16s. 0d. |
| (16) Loss £1 18s. 4d. | (17) £8 8s. 0d. | (18) £306 8s. 9d. |
| (19) £23 13s. 5d. | (20) £8 14s. 0¾d. | (21) £1169 2s. 9¾d. |
| (22) £260 12s. 1¾d. | (23) £1851 1s. 3d. | (24) £3 16s. 4d. |
| (25) Gains £1 5s. 7½d. | (26) £0 11s. 2¼d. | (27) £4 2s. 4½d. |
| (28) 2nd carriage cost £234 10s. 8¾d.; gain £6 19s. 6¾d. | | |
| (29) £31 11s. 7d. | (30) £18 17s. 4d. | (31) 532 quarters. |
| (32) £21 12s. 6d.; £16 2s. 6d.; £16 2s. 6d.; £16 2s. 6d. | | |
| (33) 16. | (34) 5 hours. | (35) £117 0s. 0d. |
| (36) £0 0s. 3¼d. | (37) Gain £4 15s. 6d. | |
| (38) 826 Eng. ells 2 qrs. 2 nls. | | |
| (39) 10 tons 7 cwt. 2 qrs. 12 lbs. 3 oz. 7 drs. | (40) Saves £2 12s. 1d. | |
| (41) Gain £0 18s. 0½d. | (42) Saves £21 13s. 4½d. | |
| (43) £87 17s. 3¾d. | (44) £70 5s. 9¾d. | |
| (45) £383 7s. 6d. | (46) 20. | (47) £516 15s. 4d. |
| (48) 2916392420 mls. 3 fur. 4P. 2 yds. 1 ft. 3 in. | | |
| (49) £2987 0s. 0d. | | |
| (50) A man's share, £72 13s. 6d.; a woman's, £24 4s. 6d.; a child's, £6 1s. 1½d. | | |

EXERCISE XVII.

- | | | | | |
|-----------|-----------|-----------|-----------|-----------|
| (1) 118. | (2) 213. | (3) 31. | (4) 37. | (5) 1. |
| (6) 41. | (7) 71. | (8) 83. | (9) 89. | (10) 87. |
| (11) 91. | (12) 97. | (13) 101. | (14) 103. | (15) 107. |
| (16) 109. | (17) 333. | (18) 283. | (19) 41. | (20) 293. |
| (21) 483. | (22) 337. | (23) 271. | (24) 787. | (25) 983. |

EXERCISE XVIII.

- | | | | | |
|----------------------------|-----------------------------|-----------------------------|----------------------------|------------------------------|
| (1) $\frac{41}{7}$. | (2) $\frac{21}{9}$. | (3) $\frac{248}{7}$. | (4) $\frac{892}{11}$. | (5) $\frac{949}{15}$. |
| (6) $\frac{224}{17}$. | (7) $\frac{2542}{21}$. | (8) $\frac{1881}{135}$. | (9) $\frac{24881}{25}$. | (10) $\frac{3615}{41}$. |
| (11) $\frac{6948}{71}$. | (12) $\frac{80697}{514}$. | (13) $\frac{145125}{183}$. | (14) $\frac{69331}{100}$. | (15) $\frac{560441}{1000}$. |
| (16) $\frac{4057}{83}$. | (17) $\frac{8820}{91}$. | (18) $\frac{1529}{17}$. | (19) $\frac{35738}{189}$. | (20) $\frac{41678}{178}$. |
| (21) $\frac{11871}{100}$. | (22) $\frac{317091}{800}$. | (23) $\frac{19422}{103}$. | (24) $\frac{69165}{118}$. | (25) $\frac{165299}{190}$. |

EXERCISE XIX.

- | | | | | |
|-----------------------------|-----------------------------|-----------------------------|---------------------------|------------------------------|
| (1) $4\frac{6}{7}$. | (2) $9\frac{1}{3}$. | (3) $11\frac{1}{10}$. | (4) $36\frac{2}{3}$. | (5) $13\frac{1}{13}$. |
| (6) 21. | (7) $22\frac{1}{27}$. | (8) $71\frac{5}{71}$. | (9) $54\frac{1}{27}$. | (10) $10\frac{19}{50}$. |
| (11) $100\frac{447}{500}$. | (12) $102\frac{5}{81}$. | (13) $104\frac{1}{28}$. | (14) $89\frac{5}{89}$. | (15) 101. |
| (16) $17\frac{94}{111}$. | (17) $135\frac{17}{26}$. | (18) $103\frac{33}{41}$. | (19) $62\frac{91}{111}$. | (20) $78\frac{7}{11}$. |
| (21) $197\frac{89}{255}$. | (22) $104\frac{135}{136}$. | (23) $192\frac{339}{512}$. | (24) $625\frac{1}{2}$. | (25) $191\frac{457}{8000}$. |

EXERCISE XX.

- | | | | | |
|------------------------|------------------------|------------------------|------------------------|------------------------|
| (1) $\frac{10}{13}$. | (2) $\frac{1}{2}$. | (3) $\frac{11}{12}$. | (4) $\frac{8}{9}$. | (5) $\frac{12}{13}$. |
| (6) $\frac{1}{2}$. | (7) $\frac{10}{11}$. | (8) $\frac{15}{18}$. | (9) $\frac{5}{9}$. | (10) $\frac{5}{17}$. |
| (11) $\frac{31}{32}$. | (12) $\frac{5}{7}$. | (13) $\frac{9}{13}$. | (14) $\frac{7}{15}$. | (15) $\frac{17}{19}$. |
| (16) $\frac{8}{13}$. | (17) $\frac{2}{13}$. | (18) $\frac{13}{20}$. | (19) $\frac{20}{31}$. | (20) $\frac{17}{18}$. |
| (21) $\frac{2}{4}$. | (22) $\frac{11}{12}$. | (23) $\frac{11}{13}$. | (24) $\frac{17}{21}$. | (25) $\frac{19}{25}$. |
| (26) $\frac{2}{8}$. | (27) $\frac{2}{3}$. | (28) $\frac{3}{7}$. | (29) $\frac{23}{25}$. | (30) $\frac{3}{8}$. |
| (31) $\frac{1}{13}$. | (32) $\frac{21}{22}$. | (33) $\frac{49}{80}$. | (34) $\frac{9}{16}$. | (35) $\frac{23}{25}$. |
| (36) $\frac{4}{11}$. | (37) $\frac{9}{7}$. | (38) $\frac{11}{13}$. | (39) $\frac{7}{11}$. | (40) $\frac{51}{53}$. |

EXERCISE XXI.

- | | | | | |
|-----------------------|------------------------|------------------------|------------------------|----------------------|
| (1) $\frac{1}{2}$. | (2) $1\frac{1}{2}$. | (3) $\frac{1}{3}$. | (4) $1\frac{2}{3}$. | (5) $\frac{1}{2}$. |
| (6) $\frac{1}{2}$. | (7) $\frac{4}{5}$. | (8) 5. | (9) $3\frac{3}{4}$. | (10) $\frac{2}{3}$. |
| (11) $\frac{1}{4}$. | (12) $\frac{5}{8}$. | (13) 196. | (14) 1. | (15) 9. |
| (16) $1\frac{1}{2}$. | (17) $3\frac{5}{12}$. | (18) $3\frac{7}{12}$. | (19) $17\frac{1}{3}$. | (20) 5. |
| | (21) $4\frac{1}{4}$. | | (22) $41\frac{3}{5}$. | |

EXERCISE XXII.

- | | | | | |
|--------------|-------------|-------------|-------------|-------------|
| (1) 48. | (2) 75. | (3) 36. | (4) 35. | (5) 720. |
| (6) 63. | (7) 24. | (8) 132. | (9) 900. | (10) 780. |
| (11) 144. | (12) 176. | (13) 624. | (14) 2940. | (15) 720. |
| (16) 1260. | (17) 14280. | (18) 480. | (19) 1080. | (20) 950. |
| (21) 864. | (22) 5400. | (23) 39600. | (24) 1260. | (25) 2016. |
| (26) 2736. | (27) 5040. | (28) 3240. | (29) 3780. | (30) 97020. |
| (31) 360360. | (32) 720. | (33) 30240. | (34) 1260. | (35) 1440. |
| (36) 7560. | (37) 36000. | (38) 10080. | (39) 75600. | (40) 50400. |

EXERCISE XXIII.

- | | | |
|--|--|--|
| (1) $\frac{6, 20, 21, 25}{30}$. | (2) $\frac{40, 45, 48, 50}{60}$. | (3) $\frac{576, 270, 560, 225}{720}$. |
| (4) $\frac{160, 135, 36, 20}{240}$. | (5) $\frac{204, 306, 660, 17}{748}$. | |
| (6) $\frac{180, 100, 336, 75, 110}{480}$. | (7) $\frac{380, 96, 372, 190, 57}{456}$. | |
| (8) $\frac{84, 70, 77, 32, 208}{224}$. | (9) $\frac{132, 120, 140, 187, 96, 2}{330}$. | |
| (10) $\frac{660, 405, 130, 160, 520, 252}{720}$. | (11) $\frac{168, 525, 490, 384, 378, 385}{1680}$. | |
| (12) $\frac{1350, 768, 1584, 1150, 825, 10}{2400}$. | | |
| (13) $\frac{3600, 2700, 5480, 3325, 7224, 7644}{8400}$. | | |
| (14) $\frac{1260, 896, 840, 665, 1020, 1302}{1400}$. | | |
| (15) $\frac{9000, 2160, 5355, 3850, 4788, 11466}{12600}$. | | |

EXERCISE XXIV.

- | | | | | |
|------------------------|--------------------------|-------------------------|---------------------------|-------------------------|
| (1) 2. | (2) $1\frac{1}{4}$. | (3) $3\frac{1}{20}$. | (4) $6\frac{197}{360}$. | (5) $3\frac{11}{240}$. |
| (6) $15\frac{9}{16}$. | (7) $4\frac{1}{4}$. | (8) $7\frac{17}{24}$. | (9) $10\frac{23}{144}$. | (10) $8\frac{9}{16}$. |
| (11) $9\frac{9}{21}$. | (12) $15\frac{7}{20}$. | (13) $3\frac{3}{20}$. | (14) $10\frac{1}{30}$. | (15) 24. |
| (16) $13\frac{1}{2}$. | (17) $4\frac{53}{96}$. | (18) $4\frac{1}{21}$. | (19) $4\frac{1}{25}$. | (20) $3\frac{3}{20}$. |
| (21) $3\frac{1}{42}$. | (22) $12\frac{1}{2}$. | (23) $3\frac{1}{3}$. | (24) $18\frac{31}{80}$. | (25) $1\frac{37}{48}$. |
| (26) $3\frac{7}{16}$. | (27) $5\frac{37}{100}$. | (28) $3\frac{19}{80}$. | (29) $16\frac{11}{144}$. | (30) $2\frac{1}{36}$. |
| | (31) $77\frac{31}{48}$. | | (32) $56\frac{1}{25}$. | |

EXERCISE XXV.

- (1) $\frac{1}{18}$; $\frac{7}{18}$; $\frac{3}{40}$. (2) $\frac{1}{21}$; $1\frac{1}{8}$; $\frac{8}{21}$. (3) $\frac{1}{2}$; $\frac{3}{10}$; $1\frac{7}{32}$.
 (4) $1\frac{1}{40}$; $7\frac{9}{77}$; $1\frac{1}{8}$. (5) $12\frac{2}{11}$; $6\frac{1}{2}$; $3\frac{17}{175}$. (6) $4\frac{33}{40}$; $8\frac{45}{48}$; $16\frac{35}{38}$.
 (7) $1\frac{9}{20}$; $\frac{11}{12}$. (8) $1\frac{1}{35}$. (9) $10\frac{17}{24}$. (10) $3\frac{7}{48}$. (11) $\frac{35}{38}$.
 (12) $6\frac{11}{16}$. (13) $14\frac{19}{117}$. (14) $11\frac{34}{39}$. (15) $11\frac{26}{189}$. (16) $26\frac{1}{4}$.
 (17) $2\frac{1}{12}$. (18) $5\frac{23}{32}$. (19) $26\frac{1}{4}$. (20) $61\frac{99}{135}$.

EXERCISE XXVI.

- (1) $1\frac{1}{2}$; $2\frac{2}{3}$; $\frac{4}{5}$. (2) 5 ; $\frac{9}{10}$; $1\frac{1}{2}$. (3) $7\frac{4}{18}$; $1\frac{1}{18}$; $7\frac{1}{2}$.
 (4) 5 ; $1\frac{1}{2}$; $8\frac{3}{4}$. (5) 4 ; $5\frac{1}{4}$. (6) $10\frac{5}{7}$; $1\frac{1}{16}$.
 (7) $6\frac{1}{12}$; $16\frac{3}{8}$. (8) 20 ; $21\frac{3}{11}$.

EXERCISE XXVII.

- (1) 4 ; $1\frac{7}{8}$; $\frac{4}{5}$; $\frac{1}{4}$; $\frac{1}{2}$; $1\frac{3}{8}$; $1\frac{1}{4}$; 2 .
 (2) $\frac{3}{8}$; $2\frac{1}{2}$; $\frac{5}{8}$; 7 ; $6\frac{2}{3}$; $2\frac{1}{12}$; $1\frac{5}{16}$; $1\frac{11}{16}$.
 (3) $\frac{1}{5}$; $\frac{3}{8}$; $1\frac{1}{2}$; $4\frac{5}{8}$. (4) $\frac{9}{10}$; $\frac{3}{18}$; $1\frac{13}{32}$; $9\frac{3}{43}$. (5) $2\frac{6}{7}$; $\frac{2}{3}$.
 (6) $7\frac{9}{16}$; 4 ; $5\frac{1}{4}$. (7) $6\frac{2}{3}$; $3\frac{23}{32}$; $\frac{4}{16}$; 10 ; $5\frac{5}{8}$; $1\frac{5}{16}$; $4\frac{1}{2}$.
 (8) $\frac{1}{2}$; $2\frac{1}{2}$; $9\frac{1}{8}$; $1\frac{8}{9}$; $3\frac{3}{10}$; $1\frac{5}{16}$; $8\frac{1}{8}$; $2\frac{15}{32}$.
 (9) 7 ; $3\frac{3}{8}$; $8\frac{2}{3}$; $2\frac{3}{8}$; $1\frac{1}{2}$; $3\frac{7}{8}$. (10) $2\frac{1}{10}$; $1\frac{1}{2}$; $4\frac{2}{3}$; $\frac{5}{8}$.
 (11) $2\frac{3}{4}$; $\frac{5}{16}$; 1 ; $\frac{13}{32}$. (12) $12\frac{2}{3}$; $\frac{2}{3}$. (13) $15\frac{1}{8}$; 6 ; $\frac{24}{25}$.
 (14) $2\frac{1}{8}$; $\frac{2}{3}$. (15) $\frac{3}{7}$; $1\frac{1}{2}$. (16) 1 . (17) $\frac{3}{4}$.
 (18) 21 . (19) $14\frac{2}{19}$. (20) 1 ; 0 .

EXERCISE XXVIII.

- (1) $8s. 9d.$; $\pounds 2 5s.$; $10s.$; $\pounds 1 1s.$; $15s. 3\frac{3}{4}d.$.
 (2) $\pounds 1 2s. 6d.$; $\pounds 3 10s.$; $\pounds 4 8s. 0d.$.
 (3) $\pounds 1 17s. 9\frac{1}{2}d.$; $11s. 8d.$; $\pounds 5 4s. 0\frac{1}{2}d.$; $\pounds 19 13s. 2d.$.
 (4) $\pounds 36 16s. 0\frac{1}{2}d.$; $\pounds 15 2s. 6d.$; $\pounds 6 12s. 8d.$; $\pounds 7 19s. 4d.$.
 (5) $\pounds 6 3s. 2\frac{2}{3}d.$; $\pounds 3 13s. 2\frac{19}{32}d.$; $\pounds 10 15s. 7d.$; $5s. 7\frac{1}{2}d.$.
 (6) $\pounds 4 6s. 8\frac{23}{32}d.$; $\pounds 41 8s. 0\frac{1}{2}d.$; $\pounds 29 3s. 4d.$; $\pounds 9 2s. 4\frac{25}{32}d.$.
 (7) $\pounds 3 0s. 3d.$; $\pounds 6 16s. 10\frac{17}{32}d.$; $\pounds 2 1s. 0\frac{1}{2}d.$; $\pounds 13 12s. 1\frac{7}{8}d.$.
 (8) $\pounds 11 6s. 3d.$; $\pounds 2 19s. 10\frac{11}{30}d.$; $1 \text{ ton } 6 \text{ cwt. } 2 \text{ qrs. } 18 \text{ lbs. } 10 \text{ oz. } 10\frac{3}{8} \text{ drs. } 4 \text{ cwt. } 3 \text{ qrs. } 8 \text{ lbs.}$.
 (9) $5 \text{ cwt. } 2 \text{ qrs. } 17 \text{ lbs. } 5 \text{ oz. } 1\frac{5}{11} \text{ drs. } 1 \text{ ton } 6 \text{ cwt. } 2 \text{ qrs. } 7 \text{ lbs. } 1 \text{ cwt. } 3 \text{ qrs. } 22 \text{ lbs. } 4 \text{ oz. } 5\frac{9}{11} \text{ drs. } \pounds 11 0s. 9\frac{3}{8}d.$.
 (10) $8 \text{ cwt. } 0 \text{ qrs. } 2 \text{ lbs. } 12 \text{ oz. } 8\frac{23}{144} \text{ drs. } 1 \text{ lb. } 8 \text{ oz. } 7 \text{ drs. } 1 \text{ sc. } 13\frac{3}{4} \text{ grs. } 3 \text{ qrs. } 12 \text{ lbs. } \pounds 1 19s. 9\frac{3}{11}d.$.
 (11) $355 \text{ miles } 1 \text{ fur. } 36 \text{ pls. } 5 \text{ yds. } 1 \text{ ft. } 0\frac{2}{14} \text{ in. } 4 \text{ months } 2 \text{ wks. } 0\frac{3}{28} \text{ dys. } 3 \text{ miles } 19\text{A. } 3\text{R. } 37\frac{31}{40} \text{ p. } 12 \text{ wks. } 3 \text{ dys. } 22\frac{31}{48} \text{ hrs.}$

- (12) £331 15s. 11 $\frac{5}{8}$ d.; £72 19s. 9 $\frac{3}{4}$ d.; 4s. 6d.; 12 cwt. 0 qrs. 6 $\frac{5}{8}$ lbs.
 (13) £1 19s. 9d.; 6 miles 7 fur. 68 yds. 1 ft. 3 $\frac{2}{3}$ in.; £8 12s. 2 $\frac{1}{2}$ d.;
 53 miles 7 fur. 207 yds. 0 ft. 11 $\frac{5}{12}$ in.
 (14) £6 2s. 11d.; 5 days 20 hrs. 6 min. 41 $\frac{3}{25}$ sec.
 (15) £5 8s. 7 $\frac{7}{8}$ d.; £22 11s. 6d.
 (16) £7 19s. 6 $\frac{11}{16}$ d.; 1 ton 8 cwt. 2 qrs. 15 $\frac{3}{8}$ lbs.

EXERCISE XXIX.

- (1) $\frac{1}{2}$; $\frac{3}{4}$. (2) $\frac{4}{5}$; $3\frac{1}{2}$. (3) $\frac{22}{3}$; $\frac{7}{25}$. (4) $\frac{4}{5}$; $\frac{3}{5}$.
 (5) $\frac{11}{10}$; $3\frac{1}{4}$. (6) $\frac{8}{19}$; $3\frac{1}{33}$. (7) $\frac{5}{21}$; $1\frac{1}{4}$. (8) $1\frac{24}{23}$; $1\frac{13}{55}$.
 (9) $\frac{19}{26}$; $\frac{6}{13}$. (10) $\frac{3}{20}$; $2\frac{2}{7}$. (11) $\frac{5}{17}$; $\frac{29}{95}$. (12) $1\frac{7}{12}$; $\frac{5}{28}$.
 (13) $\frac{2}{15}$; 8. (14) $\frac{5}{77}$; $1\frac{5}{27}$. (15) $\frac{24}{119}$; $1\frac{1}{47}$. (16) $353\frac{5}{11}$; $13\frac{4}{9}$.
 (17) $1\frac{1}{11}$; 36. (18) $3\frac{5}{13}$; $\frac{1}{8}$. (19) $\frac{19}{48}$; $\frac{253}{5760}$. (20) $1\frac{57}{84}$; $\frac{55}{84}$.

EXERCISE XXX.

- (1) $\frac{1}{2}$; $\frac{4}{9}$. (2) $\frac{3}{200}$; $\frac{5}{9}$. (3) $\frac{1}{18}$; $\frac{1}{84}$. (4) $1\frac{1}{4}$; $\frac{7}{18}$.
 (5) $\frac{85}{324}$; $\frac{5}{8}$. (6) 2; $\frac{5}{28}$. (7) $\frac{14}{15}$; $\frac{2}{7}$. (8) $\frac{5}{8}$; $\frac{1}{2}$.
 (9) $7\frac{1}{3}$; $2\frac{11}{16}$. (10) $1\frac{1}{8}$; $3\frac{81}{256}$. (11) $\frac{228}{55}$; $5\frac{185}{378}$. (12) $\frac{5}{8}$; $\frac{7}{9}$.
 (13) $1\frac{23}{40}$; $3\frac{9}{128}$. (14) $\frac{4}{5}$; $\frac{35}{48}$. (15) $\frac{6}{7}$; $2\frac{19}{37}$. (16) $1\frac{3}{16}$; $1\frac{57}{432}$.
 (17) $2\frac{2}{7}$; $\frac{6}{17}$. (18) $\frac{15}{44}$; $\frac{59}{490}$. (19) $2\frac{1}{4}$; $\frac{29}{40}$. (20) $\frac{24}{85}$; $1\frac{1}{3}$.

EXERCISE XXXI.

- (1) $3\frac{1}{3}$. (2) $2\frac{1}{3}$. (3) $1\frac{1}{2}$; $\frac{1}{4}$. (4) $\frac{11}{81}$.
 (5) £633 18s. 6 $\frac{2}{3}$ d.; 10 $\frac{2}{3}$ s. (6) $2\frac{11}{16}$; $6\frac{13}{14}$. (7) £14862.
 (8) $\frac{16}{25}$. (9) $\frac{3}{4}$. (10) £2 18s. 4d. (11) $3\frac{5}{16}$; $1\frac{1}{4}$.
 (12) $1\frac{107}{224}$. (13) £1 18s. 11 $\frac{1}{2}$ d. (14) 5.
 (15) $\frac{8}{9}$, $\frac{7}{8}$, $\frac{11}{13}$, $\frac{5}{6}$, $\frac{4}{5}$, $\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{13}$, $\frac{5}{9}$, $\frac{6}{11}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{1}{7}$, $\frac{1}{10}$.
 (16) 49 $\frac{1}{3}$ yds.; £9 10s. 1 $\frac{2}{3}$ d. (17) $\frac{1}{6}$. (18) $\frac{8}{5}$; $2\frac{3}{4}$.
 (19) £5 10s. 6 $\frac{5}{8}$ d. (20) 90. (21) $2\frac{1}{2}$.
 (22) $\frac{4}{9}$. (23) $\frac{1}{20}$. (24) $\frac{5}{8}$. (25) £1911.
 (26) 270. (27) 4 $\frac{19}{20}$ dys. (28) $\frac{3}{8}$. (29) 2.
 (30) 9 $\frac{3}{8}$ dys. (31) £127195 $\frac{5}{8}$. (32) $\frac{3}{4}$. (33) £3 13s. 4d.
 (34) 4. (35) 68 $\frac{1}{2}$. (36) £540.
 (37) A, 9 $\frac{3}{8}$ dys.; B, 18 dys.; C, 48 dys.; A, B, and C, 5 $\frac{1}{3}$ dys.
 (38) $\frac{1}{11}$. (39) £2738 1s. 10 $\frac{5}{8}$ d.; £2261 18s. 1 $\frac{1}{2}$ d.
 (40) 17,802. (41) 22 $\frac{28}{121}$ min. (42) 900 guineas.
 (43) £329 8s. 10 $\frac{3}{4}$ d. (44) 6. (45) $\frac{17}{13}$.
 (46) $\frac{1}{8}$. (47) £16200; £567.
 (48) 3 qrs. 1 bus. 2 pks. 1 $\frac{51}{1109}$ gal. (49) 2 hrs. (50) $\frac{3}{7}$.
 (51) 6 inches. (52) $\frac{5}{16}$. (53) 384; £12 11s. 10 $\frac{1}{2}$ d.
 (54) $\frac{1}{5}$. (55) $\frac{3}{25}$; £35 18s. 4 $\frac{20}{9}$ d. (56) £275.
 (57) 2 $\frac{2}{3}$ days. (58) £3637.

EXERCISE XXXII.

- (1) $\cdot 3$; $1\cdot 9$; $\cdot 77$; $\cdot 119$. (2) $1\cdot 027$; $\cdot 001$; $\cdot 0036$; $\cdot 0719$.
 (3) $\cdot 1267$; $\cdot 00009$; $\cdot 00017$; $5\cdot 1792$.

EXERCISE XXXIII.

- (1) $\frac{9}{10}$; $\frac{19}{100}$; $\frac{1}{40}$; $\frac{17}{20}$. (2) $\frac{7}{2000}$; $1\frac{27}{1000}$; $11\frac{229}{400}$; $2\frac{609}{8000}$.
 (3) $7\frac{25}{84}$; $9\frac{35}{128}$; $15\frac{1}{40000}$; $7\frac{1}{8000}$.

EXERCISE XXXIV.

- (1) $\cdot 625$; $\cdot 5625$; $\cdot 072$; $\cdot 432$; $\cdot 075$; $\cdot 1015625$.
 (2) $1\cdot 4$; $\cdot 26$; $\cdot 0444$; $\cdot 03104$.
 (3) $1\cdot 013671875$; $\cdot 189375$; $7\cdot 15625$; $\cdot 0009765625$.
 (4) $14\cdot 0144768$; $7\cdot 073974609375$.
 (5) $11\cdot 001696$; $\cdot 030517578125$.
 (6) $1\cdot 84$; $\cdot 001875$. (7) $2\cdot 6015625$.

EXERCISE XXXV.

- (1) $3\cdot 6$; $1\cdot 285714$; $2\cdot 027$; $2\cdot 076923$.
 (2) $\cdot 009$; $3\cdot 6$; $\cdot 3087$; $\cdot 8225806451612903$.
 (3) $\cdot 0378$; $1\cdot 1571428$; $1\cdot 483$; $1\cdot 1076923$.
 (4) $3\cdot 047619$; $2\cdot 03$; $\cdot 02439$; $\cdot 023255813953488372093$.
 (5) $\cdot 020408163265306122448979591836734693877551$;
 $\cdot 0188679245283$; $\cdot 714285$; $\cdot 0082644628099173553719$.

EXERCISE XXXVI.

- (1) $\frac{2}{3}$; $\frac{3}{11}$; $\frac{4}{11}$; $\frac{8}{27}$. (2) $2\frac{25}{198}$; $3\frac{7}{33}$; $\frac{1}{27}$; $\frac{19}{74}$.
 (3) $\frac{52}{111}$; $\frac{4}{7}$; $21\frac{7003}{22222}$; $1\frac{75}{148}$. (4) $\frac{1875}{2222}$; $\frac{5625}{22222}$; $4\frac{3434}{4995}$; $2\frac{3}{7}$.
 (5) $2\frac{11}{23}$; $3\frac{3}{14}$; $6\frac{5}{14}$; $\frac{7}{65}$.

EXERCISE XXXVII.

- (1) $35\cdot 79055$. (2) $192\cdot 70900$.
 (3) $26\cdot 86079$. (4) $163\cdot 911647$.
 (5) $27\cdot 622776$. (6) $1\cdot 96538$; $\cdot 964132$.
 (7) $2\cdot 58611$; $11\cdot 445$. (8) $\cdot 22765$; $\cdot 00775$.
 (9) $\cdot 00059033$; $\cdot 0001$. (10) $\cdot 013333$; $1\cdot 2109$.

EXERCISE XXXVIII.

- (1) $21\cdot 13511166$. (2) $27\cdot 28314493$.
 (3) $95\cdot 4439485350340$. (4) $\cdot 61251$; $\cdot 455932$.
 (5) $\cdot 305797$; $\cdot 0015$. (6) $12\cdot 972998$; $109\cdot 82428571$.

EXERCISE XXXIX.

- | | |
|--------------------------|-----------------------|
| (1) 2·088; 10·8864. | (2) 203133; 491·0239. |
| (3) 0015364; 5074238·84. | (4) 0147118; 1562548. |
| (5) 2·7664; 6·885. | (6) 4481568; 5·7024. |

EXERCISE XL.

- | | |
|----------------------|--------------------------|
| (1) 12·5; 6250. | (2) 444911·25; 192000. |
| (3) 1458; 2048000. | (4) 4802000; 0004. |
| (5) 40000; 360. | (6) 578; 1131·896, &c. |
| (7) 12; 6701·91. | (8) 101200000; 00389017. |
| (9) 3890170; 000976. | (10) 164000000; 000479. |
| (11) 537142·857142. | |

EXERCISE XLI.

- | | |
|------------------------|-----------------------------|
| (1) 1·18; 1. | (2) 39867324; 5·3253995. |
| (3) 1008; 47·31540155. | (4) 25·9729390; 79·4154188. |
| (5) 958·549120; 8. | (6) 548076923; 73·5. |
| (7) 135; 54. | (8) 3·8643; 2·327. |
| (9) 12·5461; 4·45. | (10) 2·54; 04. |

EXERCISE XLII.

- | | | |
|--|---|-----------------------------|
| (1) 7s. | (2) 2s. 6d. | (3) £2 9s. |
| (4) £127 10s. | (5) 10s. 11d. | (6) £1 1s. 4½d. |
| (7) £29 1s. 3d. | (8) 17s. 1½d. | (9) £13 7s. 9d. |
| (10) £21 3s. 0½d. | (11) 1 ton 15 cwt. 3 qrs. | |
| (12) 15 lbs. 12 oz. | (13) 2 fur. 16p. 3 yds. 0 ft. 10½ in. | |
| (14) 5 yds. 1 ft. 4½ in. | (15) 2A. 0R. 27P. 6 yds. 5 ft. 128½ in. | |
| (16) 99 sq. yds. | (17) 1 gal. 1 pt. | (18) 16 wks. 0 dys. 12 hrs. |
| (19) £162 1s. 9½d. | (20) £34 12s. 10¾d. | (21) £35 0s. 9½d. |
| (22) £35 19s. 7½d. | (23) £1 18s. 3½d. | (24) £70 7s. |
| (25) 15s. 10½d. | (26) £1 18s. 6¾d. | (27) £1 9s. 8½d. |
| (28) £16 3s. 6d. | (29) 3 fur. 33p. 1 ft. 9½ in. | |
| (30) 3R. 37P. 16 yds. 6 ft. 111 in. | | |
| (31) 1 cwt. 3 qrs. 12 lbs. 12 oz. ½ dr. | | |
| (32) 7 oz. 14 dwts. 10½ grs. | | |
| (33) 1 lb. 10 oz. 4 drms. 4 grs. | | |
| (34) 6 wks. 5 dys. 18 hrs. 51 min. 3 sec. | | |
| (35) £6 11s. 3¾d. | | |
| (36) 1 mile 2 fur. 31p. 1 yd. 2 ft. 3½ in. | | |
| (37) 5A. 1R. 10P. | | |
| (38) 7 cwt. 1 qr. 26 lbs. 12 oz. | | |

- (39) 11s. (40) £135 18s. (41) 9s. 2½d.
 (42) 11s. 0½d. (43) 3s. 10d. (44) 4s. 3d.
 (45) 1 cwt. 1 qr. 17 lbs. 8 oz. (46) £5 0s. 10½d.
 (47) 10s. 1½d. (48) £76 10s. (49) £76 10s.
 (50) £69 1s. 7½d. (51) £4 5s. 9d. (52) £7 6s.
 (53) £4 13s. 4d. (54) £17 7s. (55) £48 5s. 8½d.
 (56) £9. (57) 10 guineas. (58) 3 bus. 1 pk. 1 qt. ½ pt.
 (59) 2 mls. 18p. 1 yd. 1 ft. 3 in.
 (60) 5 oz. 3 drs. 1 scr. 10 grs.
 (61) 1A. 1R. 5P. 21 yds. 5 ft. 66⅞ in.
 (62) 527 tons 13 cwt. 2 qrs. 8 lbs.
 (63) 16 wks. 4 days 13 hrs. 12 min.
 (64) 1 qr. 3 n. ¼ in. (65) 4 mls. 6p. 3 yds. 9 in.
 (66) 9 cwt. 1 qr. 20 lbs. (67) 4 cwt. 1 qr. 10 lbs.
 (68) 3 fur. 21p.
 (69) 9A. 1R. 20P. 21 yds. 7 ft. 71⅓ in.
 (70) 1A. 11p.

EXERCISE XLIII.

- (1) ·375; ·7. (2) ·51; ·4625. (3) ·5; ·15125.
 (4) ·184375; ·15625. (5) ·625; 1·25. (6) ·49625; ·5627.
 (7) 11·875; 1·3032407. (8) ·087; ·2175317460.
 (9) ·575; 1·686728395061. (10) 3·69125; 1·51083.
 (11) ·306875; 2·8246527. (12) ·269134521484375; 2·7625.
 (13) ·482142857; ·84765625. (14) ·00634765625; 9·14.
 (15) 2·97265625; ·237939453125. (16) ·06; 12·25.
 (17) ·04; ·97. (18) ·000003720238095; 3·4160714285.
 (19) 1·0888671875; ·3482142857. (20) ·640625; ·4631696428571.
 (21) ·59121527; ·79355158730. (22) ·8748697916; ·8447916.
 (23) ·375; 1·7790625. (24) 1·72204861; 1·14416.
 (25) ·70033482142857. (26) ·03794177827380952.
 (27) ·0135173797607421875. (28) ·49005661.
 (29) ·41375248015873. (30) ·8703123365129743303571426.
 (31) ·79195075. (32) ·783812830687.
 (33) ·362073863. (34) ·13061067019400352733686.
 (35) ·97060185.

EXERCISE XLIV.

- (1) ·38125; £1 0s. 3½d.
 (2) ·0165289256198347107438; ·0693; $\frac{49}{222}$; $\frac{1209}{3333}$.
 (3) 7 lbs. 14 oz. 7 drs.; ·82125.
 (4) ·12; ·3571428; $\frac{115}{132}$; $\frac{119}{130}$; 9s. 6d.

- (5) £2 1s. 10½d. (6) 2265625; £3 11s. 10½d.
 (7) 2·8005997972474. (8) 3s. 4½d.
 (9) 7 cwt. 16 lbs.; 15s. 5d.; ·077083.
 (10) $\frac{1389}{3003}$; $\frac{4}{31}$; ·27734375. (11) 1s. 5d.
 (12) 9·575 = 9 $\frac{23}{40}$. (13) 6s. 7d.; 2s. 7d. (14) 12s. 1d.
 (15) 39p. 17 yds. 0 feet 64·8 in.; ·30433566.
 (16) ·00030768; ·641.
 (17) 3p. 9 yds. 4 ft. 85½ in.; 21p. 10 in.
 (18) £1 18s. 5½d. (19) 11. (20) 798½ yds.
 (21) 8s. 4d.; £411 3s. 3d. (22) £5.
 (23) 1d.; ·00416. (24) ·0002935; 24; ·70375.
 (25) £1 2s. 3 $\frac{20}{100}$ d.; £65 14s. 7d. (26) £2 1s. 3d.
 (27) £2 4s.; ·0008. (28) 4s. 6d.; ·2784693526170798898071625344.
 (29) 87·1. (30) 1 oz. 6 dwts. 16 grs.
 (31) 2·571428. (32) ·02652; 369863·01369863; ·57875.
 (33) £6 15s. 0½d.; 5 yds. 3 qrs. 2 nls. 1½ in.
 (34) ·4158; ·4861; 1 $\frac{19}{32}$; $\frac{31}{32}$; ·4725. (35) £3 3s. 5d.
 (36) 3·75378; 1·1764; 99; ·05; 5·823267.
 (37) 1 fur. 22p. 3 yds. 1 ft. 1 in.; 18p. 1 yd. 6 ft. 18 in.
 (38) 2·6583. (39) £1 0s. 4d.; 1·936507.
 (40) 8 cwt. 3 qrs. 12 lbs. 9 oz. 2½ drs. (41) £218 15s. 11½d.
 (42) 2518 lbs. 13 dwts. 8 grs.
 (43) £1 7s. 6½d.; £16 18s. 10½d.

EXERCISE XLV.

- (1) 28 ft. 7 in. 4'. (2) 45 ft. 4 in. 8'. (3) 79 ft. 4 in. 9'.
 (4) 36 ft. 6 in. 9'. (5) 81 ft. 6 in. 6'. (6) 147 ft. 10 in. 3'.
 (7) 63 ft. 5 in. 3'. (8) 52 ft. 9 in. 1'.
 (9) 108 ft. 9 in. 8' 7" 6".
 (10) 52½ yds.; £11 3s. 1½d. (11) £3 3s. 11½d.
 (12) £50 9s. 7½d.; no. of stones, 868.
 (13) 247 $\frac{253}{1108}$ gals.; 1 ton 2 cwt. 15 lbs. 2 $\frac{2}{13}$ oz.
 (14) £7 14s. 6½d. (15) £5 17s.
 (16) Area of path, 362 sq. yds. 7 ft.; garden, 3071 yds. 6 ft.; cost of
 gravelling, £4 8s. 10½d. (17) £1 13s. 6½d.
 (18) 4 feet. (19) 21½ ft. (20) £45 14s. 4½d.
 (21) 111½ ft. (22) £4 9s. 4½d. (23) 12A. 5p.
 (24) £451 14s. 4½d. (25) £5 7s. 6d. (26) 3½ feet.
 (27) £4 11s. 2d. (28) 52 bullocks. (29) £4 7s. 3½d.
 (30) The diff. of area of 2 pipes, 481 $\frac{3}{8}$ sq. in.; diff. of metal, 19 cub. ft.
 875½ in. (31) £360; 154880 bricks.

- | | | |
|---------------------|--------------------------|------------------------|
| (32) 36 ft. | (33) $4\frac{1}{8}$ lbs. | (34) 46·906. |
| (35) 28. | (36) 8·485. | (37) 8·077 ft. |
| (38) 66·14 yds. | (39) 63 ft. | (40) $33\frac{3}{4}$. |
| (41) 40·5 sq. yds. | (42) 3888 sq. yds. | (43) 3072 sq. yds. |
| (44) 62·35 sq. yds. | | |

EXERCISE XLVI.

- | | | |
|-----------------------------------|--|---------------------------------------|
| (1) £72. | (2) 6 months. | (3) 82 cwt. |
| (4) £872. | (5) 20 weeks. | (6) 6d. |
| (7) 13s. 10d. | (8) 60 weeks. | (9) 12s. $6\frac{1}{2}$ d. |
| (10) 246 miles. | (11) £79 6s. 8d. | (12) 18s. $2\frac{1}{2}$ d. |
| (13) 11 tons 11 cwt. 24 lbs. | | (14) 30 yds. 2 ft. $4\frac{1}{2}$ in. |
| (15) £313 11s. 6d. | (16) 22 dys. 20 hrs. 32 min. | |
| (17) £12576 3s. $1\frac{1}{2}$ d. | (18) 8022 gals. | (19) 3s. $6\frac{3}{4}$ d. |
| (20) £388 14s. 3d. | (21) £1310 2s. 8d. | |
| (22) 17A. 1R. 21P. | (23) £20 19s. 6d. | |
| (24) £3 11s. 8d. | (25) 271 qrs. 1 pk. $1\frac{1}{2}$ galls.; £361 8s. $1\frac{1}{2}$ d. | |
| (26) 28 days. | (27) 273A. 1R. | (28) 5s. |
| (29) £21 17s. 6d. | (30) 44 sacks. | (31) £3 17s. 10d. |
| (32) £98 6s. 6d. | (33) 1 yd. $9\frac{1}{2}$ in. | (34) 68 yds. $3\frac{3}{4}$ in. |
| (35) £22137 10s. | (36) £24. | (37) £170 13s. 4d. |
| (38) 9 oz. | (39) £2964 14s. 3d. | (40) £3 3s. $2\frac{1}{2}$ d. |
| (41) 1s. 1d. | (42) £91 14s. 8d. | (43) £7 5s. 6d. |
| (44) 1s. $5\frac{1}{2}$ d. | (45) £1071 2s. 6d. | (46) £32 9s. 9d. |
| (47) £8 2s. 5d. | (48) £187 8s. $11\frac{1}{2}$ d. | (49) £294 8s. $0\frac{3}{4}$ d. |
| (50) 8d. | (51) £3 13s. 4d. | (52) 6 hrs. 20 min. |
| (53) 11s. 8d. | (54) £1905 2s. $0\frac{1}{4}$ d. | (55) £11 18s. |
| (56) 2s. | (57) 3s. $4\frac{1}{4}$ d. | (58) £588 11s. $4\frac{1}{4}$ d. |
| (59) £9637 10s. | (60) £8 13s. 4d. | (61) £1 9s. $3\frac{3}{4}$ d. |
| (62) £27 17s. $3\frac{3}{4}$ d. | (63) £362 7s. 9d. | (64) £26 9s. |
| (65) 1 cwt. 18 lbs. | (66) 4s. 2d. | (67) £29. |
| (68) 5s. 3d. | (69) £768 10s. | (70) 960 days; £28 4s. |
| (71) 1s. 4d. | (72) £154 13s. $11\frac{1}{2}$ d. | (73) 18 days. |
| (74) 1320 strokes; 36 min. | | (75) 150th page. |
| (76) 28700 bricks. | (77) £4099. | (78) £1 10s. |
| (79) £51 6s. 8d. | (80) 4 tons 12 cwt. 1 qr. 3 lbs. | |
| (81) £4. | (82) £950. | (83) £12 11s. $3\frac{1}{2}$ d. |
| (84) £3 13s. 6d. | (85) £7 1s. 8d. | (86) £108 2s. 10d. |
| (87) £6 10s. | (88) £134 7s. 1d. | (89) £13347 14s. 2d. |
| (90) 5s. | (91) 2 mon. 3 dys. 5 hrs.; 17052 miles. | |
| (92) 3 hrs. | (93) $39\frac{37}{100}$ in. 12,733,155 $\frac{795}{8837}$ French mètres. | |

- (94) 54 mls. 4 fur. 14p. 3 yds. (95) 3 hrs. 2 min. 42 sec.
 (96) 433 tuns 1 hhd. 33 galls. (97) 6 cwt. 18 lbs.
 (98) 3 cwt. 3 qrs. 22 lbs. (99) 9 mls. 1640 yds.
 (100) £3. (101) £1825. (102) 2s. 3d.
 (103) £37 14s. 2d. (104) £294. (105) 7 dys. 6 hrs. 1 min.
 (106) £117 4s. 9d. (107) £7 4s. 2d. (108) £1 3s.
 (109) £1 1s. 8d.; gain £23 9s. 10½d.
 (110) 125A.; cost per year £433 6s. 8d.; £243 15s. wool.
 (111) 16s. 6d. (112) £29 19s. 4d. (113) 6½ months.
 (114) £26 1s. 4d. (115) £1952 13s. 4d. (116) 15 seconds.
 (117) 1 year 229 dys. (118) £106 10s. 10d. (119) 25 ft. 4 in.
 (120) £9 4s. 11d. (121) £855 4s. 2d. (122) £14.
 (123) 22½ miles. (124) £1 6s. 3d. (125) £2548 15s. 3¾d.
 (126) £8 16s. (127) £45 6s. 8d. (128) £357.
 (129) £1778 18s. 8d. (130) £2458 8s. (131) £1872 8s. 8d.
 (132) £7 9s. 9d. (133) £33 17s. 10d. (134) £14862.
 (135) £759 4s. 7d. (136) £115 4s. (137) 13s. 6d.
 (138) 5d. (139) £448. (140) 1s. 3d.
 (141) £3024. (142) £1 11s. 6d. (143) 4s.
 (144) 20 ft. 9½ in. (145) £589 12s. 9d. (146) £1 19s. 3¾d.
 (147) 30½ feet. (148) 17 ft. 0¾ in.; £13 5s. 5d.
 (149) £2400. (150) £7500. (151) 10 months.
 (152) 45,718 sq. yds. 3 ft. 78 in.; £15429 19s. 1½d.
 (153) 19 cwt. 2 qrs. 6 lbs. 8 oz.; £11956 9s. 7d.
 (154) 288,000,000 gallons; weight 1289411 tons 5 cwt. 1 qr. 22 lbs.;
 depth increased 2½ in.
 (155) 12 ft. deep; 1 yr. 355 dys.

EXERCISE LXVII.

- (1) 105 bushels. (2) £150. (3) 25 days.
 (4) 18 persons. (5) 10 men. (6) £30.
 (7) 40 days. (8) 140 miles. (9) 37A. 2R.
 (10) £26 5s. (11) 25 miles. (12) £16 13s. 4d.
 (13) 130 horses. (14) £11 5s. (15) 24 acres.
 (16) 72 days. (17) 42 oxen. (18) 44 navvies.
 (19) 396 yards. (20) 48 men. (21) 6 hours.
 (22) 16s. 10½d. (23) 15 days. (24) 10 men.
 (25) 3600 geraniums. (26) 12A. 24P. (27) 135 men.
 (28) 2 tons 11 cwt. 1 qr. (29) 120 masons. (30) 40 hours.
 (31) 80 men. (32) £45 4s. 2d.

- | | |
|--|-----------------------------|
| (33) $9\frac{3}{8}$ dys. of 8 hrs. each. | (34) $21\frac{7}{8}$ acres. |
| (35) $4\frac{1}{2}$ panes. | (36) $5\frac{1}{2}$ hours. |
| (38) 6000 stones. | (39) $4\frac{1}{2}$ days. |
| | (40) 128 navvies. |

EXERCISE XLVIII.

- | | | |
|--------------------|---------------------|--------------------|
| (1) £70 2s. 6d. | (2) £360 15s. | (3) £74 15s. |
| (4) £387 10s. | (5) £321 3s. 4d. | (6) £286 13s. 4d. |
| (7) £257 6s. 6d. | (8) £405 7s. 6d. | (9) £108 1s. 3d. |
| (10) £426 5s. | (11) £560 12s. 6d. | (12) £496 8s. 9d. |
| (13) £378 11s. 8d. | (14) £285 19s. | (15) £1230 5s. 8d. |
| (16) £815 12s. 6d. | (17) £261 15s. 10d. | (18) £429 19s. 6d. |
| (19) £432 5s. | (20) £114 16s. 4d. | |

EXERCISE XLIX.

- | | | |
|--------------------|---------------------|--------------------|
| (1) £385 13s. 9d. | (2) £811 4s. 11d. | (3) £629 3s. 1d. |
| (4) £193 1s. 10d. | (5) £418 4s. 9d. | (6) £252 9s. 5d. |
| (7) £99 2s. 7d. | (8) £803 6s. | (9) £252 1s. 9d. |
| (10) £107 14s. 6d. | (11) £666 3s. 5d. | (12) £903 2s. 1d. |
| (13) £415 10s. 2d. | (14) £374 19s. 9d. | (15) £786 3s. 6d. |
| (16) £204 5s. 9d. | (17) £1196 3s. 6d. | (18) £735 19s. 9d. |
| (19) £424 18s. 5d. | (20) £1182 3s. 11d. | |

EXERCISE L.

- | | | |
|---------------------|----------------------|--------------------|
| (1) £197 19s. 10d. | (2) £226 19s. 2d. | (3) £291 10s. 1d. |
| (4) £203 12s. 3d. | (5) £347 5s. 5d. | (6) £36 5s. 11d. |
| (7) £345 17s. 9d. | (8) £645 19s. 6d. | (9) £1675 8s. 10d. |
| (10) £396 2s. | (11) £306 0s. 4d. | (12) £647 13s. 3d. |
| (13) £1111 15s. 3d. | (14) £535 9s. 2d. | (15) £2464 7s. 4d. |
| (16) £1055 5s. 9d. | (17) £1886 8s. 10d. | (18) £993 8s. 4d. |
| (19) £2071 11s. 6d. | (20) £11982 11s. 7d. | |

EXERCISE LI.

- | | | |
|---------------------------------|---------------------------------|---------------------------------|
| (1) £84 15s. $0\frac{3}{4}$ d. | (2) £537 0s. $7\frac{1}{2}$ d. | (3) £293 3s. $10\frac{3}{4}$ d. |
| (4) £277 7s. $5\frac{1}{2}$ d. | (5) £392 18s. $0\frac{3}{4}$ d. | (6) £16 12s. $7\frac{1}{2}$ d. |
| (7) £10 0s. $11\frac{1}{4}$ d. | (8) £4 7s. $3\frac{1}{2}$ d. | (9) £57 9s. $10\frac{1}{4}$ d. |
| (10) £8 11s. $6\frac{1}{2}$ d. | (11) £42 14s. $9\frac{1}{4}$ d. | (12) £50 5s. $9\frac{3}{4}$ d. |
| (13) £36 19s. $9\frac{1}{2}$ d. | (14) £119 3s. $2\frac{3}{4}$ d. | (15) £384 1s. $6\frac{1}{4}$ d. |
| (16) £394 17s. 6d. | (17) £421 5s. $3\frac{3}{4}$ d. | (18) £271 1s. 7d. |
| (19) £179 5s. 6d. | (20) £701 5s. $7\frac{1}{2}$ d. | |

EXERCISE LII.

- | | | |
|----------------------------------|----------------------------------|--------------------------------|
| (1) £39 0s. $8\frac{3}{4}d.$ | (2) £190 2s. $3d.$ | (3) £24 1s. $5\frac{11}{16}d.$ |
| (4) £15 17s. $1\frac{5}{8}d.$ | (5) £42 15s. $9\frac{3}{8}d.$ | (6) £59 5s. $3\frac{19}{32}d.$ |
| (7) £39 16s. $7\frac{3}{8}d.$ | (8) £39 3s. $6\frac{3}{4}d.$ | (9) £24 2s. $3\frac{45}{64}d.$ |
| (10) £229 3s. $1\frac{5}{8}d.$ | (11) £100 9s. $1\frac{5}{16}d.$ | (12) £11 16s. $2\frac{3}{4}d.$ |
| (13) £27 14s. $5\frac{5}{8}d.$ | (14) £11 5s. $9\frac{3}{8}d.$ | (15) £47 14s. $1\frac{3}{4}d.$ |
| (16) £63 11s. $4d.$ | (17) £4 12s. $7\frac{1}{8}d.$ | (18) £17 19s. $8\frac{5}{8}d.$ |
| (19) £13 2s. $5\frac{7}{32}d.$ | (20) £10 12s. $4\frac{17}{32}d.$ | (21) £15 2s. $0\frac{5}{8}d.$ |
| (22) £13 7s. $5\frac{15}{16}d.$ | (23) £10 7s. $7\frac{7}{8}d.$ | (24) £64 19s. $2\frac{1}{4}d.$ |
| (25) £57 4s. $10\frac{3}{8}d.$ | (26) £351 3s. $3\frac{3}{4}d.$ | (27) £897 6s. $7\frac{3}{8}d.$ |
| (28) £1468 18s. $4\frac{1}{2}d.$ | (29) £15 9s. $0\frac{13}{16}d.$ | (30) £25 4s. $7\frac{5}{8}d.$ |

EXERCISE LIII.

- | | | |
|--|-------------------------------------|-----------------------------------|
| (1) £95 16s. $3d.$ | (2) 507A. 3R. 10P. | (3) £1389 19s. $8\frac{2}{3}d.$ |
| (4) £9005 10s. | (5) £4251 6s. $6\frac{3}{4}d.$ | (6) £2864 15s. $8\frac{1}{2}d.$ |
| (7) £10 10s.; 25 p. c.; £132; $13\frac{2}{21}$ p. c. | (8) £40 16s. $8d.$ | |
| (9) £5618 16s. $11\frac{1}{2}d.$ | (10) £4452 2s. $7\frac{1}{8}d.$ | |
| (11) £369 6s.; £51 18s. $7\frac{7}{8}d.$; £831 14s. $2\frac{5}{8}d.$ | | |
| (12) £74 0s. $10\frac{1}{2}d.$; £13 9s. $3d.$ | | |
| (13) £2785 8s. $4d.$; £4854 3s. $4d.$ | | |
| (14) 5 oz. 2 scr. $15\frac{1}{4}$ grs.; entire gain £14 14s. $6\frac{3}{8}d.$; gain p. c. $56\frac{11}{21}$ | | |
| (15) £1388 18s. $4\frac{1}{2}d.$; £159 12s. $11d.$; £462 19s. $5\frac{1}{2}d.$; £8 6s. $8\frac{1}{2}d.$ | | |
| (16) £34 3s. $2\frac{17}{80}d.$ | (17) £1357 12s. $6\frac{3}{8}d.$ | (18) £27 19s. $10\frac{11}{16}d.$ |
| (19) £45 2s.; £1 17s. per doz. | (20) £188 6s. $3\frac{9}{11}d.$ | |
| (21) £101 6s. $9\frac{1}{4}d.$ | (22) £574 9s. $10\frac{205}{112}d.$ | |
| (23) Cost £23 6s. $8d.$; gain £6 13s. $4d.$ | | |
| (24) £14172193 17s. $1\frac{1}{2}d.$ | | |

EXERCISE LIV.

- | | |
|--|--------------------------|
| (1) £60; £360. | (2) £84; £784. |
| (3) £44 2s.; £464 2s. | (4) £244 16s.; £884 16s. |
| (5) £307 14s. $4\frac{1}{2}d.$; £1563 14s. $4\frac{1}{2}d.$ | |
| (6) £509 13s. $7\frac{1}{2}d.$; £2354 13s. $7\frac{1}{2}d.$ | |
| (7) £284 2s. $1\frac{1}{2}d.$; £1704 12s. $7\frac{1}{2}d.$ | |
| (8) £65 12s. $6d.$; £357 5s. $10d.$ | |
| (9) £95 12s. $1d.$; £683 18s. $9d.$ | |
| (10) £245 11s. $8\frac{1}{16}d.$; £1296 4s. $2\frac{1}{16}d.$ | |
| (11) £10 3s. $4\frac{31}{80}d.$; £42 9s. $0\frac{31}{80}d.$ | |
| (12) £149 0s. $9\frac{3}{8}d.$; £840 4s. $9\frac{3}{8}d.$ | |
| (13) £62 0s. $3\frac{3}{4}d.$; £429 10s. $3\frac{3}{4}d.$ | |

- (14) £24 17s. 10 $\frac{1}{2}$ d.; £762 10s. 4 $\frac{1}{2}$ d.
 (15) £3 6s. 8 $\frac{1}{2}$ d.; £222 6s. 8 $\frac{1}{2}$ d.
 (16) £56 0s. 0 $\frac{1}{2}$ d.; £402 15s. 0 $\frac{1}{2}$ d.
 (17) £20 11s. 7 $\frac{1}{2}$ d.; £171 1s. 7 $\frac{1}{2}$ d.
 (18) £638 15s. 5 $\frac{1}{2}$ d.; £3753 8s. 9 $\frac{1}{2}$ d.
 (19) £335 9s. 4d.; £2468 16s.
 (20) £488 5s. 3d.; £1939 2s. 9d.

EXERCISE LV.

- | | | |
|---------------------------------|----------------------------------|----------------------------------|
| (1) £10 19s. 8 $\frac{2}{3}$ d. | (2) £4 8s. | (3) £1323 2s. 8 $\frac{1}{2}$ d. |
| (4) 4 years. | (5) £1855 11s. 8d. | (6) 2 $\frac{1}{2}$ per cent. |
| (7) 3 years. | (8) £1253 3s. 4d. | (9) 6 $\frac{2}{3}$ per cent. |
| (10) 3 $\frac{1}{2}$ years. | (11) 3 $\frac{1}{2}$ years. | (12) 4 per cent. |
| (13) £527 10s. | (14) 2 $\frac{1}{3}$ years. | (15) £760. |
| (16) 64 days. | (17) 4 $\frac{1}{2}$ per cent. | (18) 6 months. |
| (19) 3 $\frac{1}{8}$ per cent. | (20) £1630 14s. | (21) 3 years. |
| (22) 5 per cent. | (23) £15768. | (24) 4 per cent. |
| (25) 6 years. | (26) £28 16s. 0 $\frac{1}{2}$ d. | (27) 3 $\frac{1}{2}$ per cent. |
| (28) 4 per cent. | (29) £103 7s. 2 $\frac{1}{4}$ d. | (30) £42203 2s. 6d. |

EXERCISE LVI.

- | | |
|--|------------------------------------|
| (1) £711 15s.; £23 14s. 6d. | (2) £701 13s. 4d.; £35 1s. 8d. |
| (3) £833 6s. 8d.; £31 5s. | (4) £812 6s. 8d.; £101 10s. 10d. |
| (5) £1639 16s. 8d.; £245 19s. 6d. | (6) £14688 6s. 8d.; £550 16s. 3d. |
| (7) £9378 13s. 4d.; £351 14s. | (8) £3651 4s.; £228 4s. |
| (9) £6352 13s. 4d.; £317 12s. 8d. | (10) £9387 10s. 8d.; £586 14s. 5d. |
| (11) £200 15s.; £3 6s. 11d. | (12) £340 5s.; £11 6s. 10d. |
| (13) £610 10s.; £5 1s. 9d. | (14) £656 16s. 8d.; £16 8s. 5d. |
| (15) £143872 10s.; £1198 18s. 9d. | (16) £73; 4s. |
| (17) £146; 12s. | (18) £175; £1 15s. |
| (19) £1095; £4 10s. | (20) £292; 16s. |
| (21) £438; £2 8s. | (22) £2044; £8 15s. |
| (23) £584; £1 4s. | (24) £1679; £5 15s. |
| (25) £1533; £5 12s. | (26) £118 12s. 6d.; £1 12s. 6d. |
| (27) £228 2s. 6d.; 18s. 9d. | (28) £267 13s. 4d.; 11s. |
| (29) £669 3s. 4d.; £2 11s. 4d. | (30) £383 5s.; 10s. 6d. |
| (31) £4083 6s. 8d.; £29 3s. 4d. | (32) £608 6s. 8d.; £2 15s. |
| (33) £713 15s. 6 $\frac{2}{3}$ d.; £1 4s. 5 $\frac{1}{2}$ d. | (34) £4866 13s. 4d.; £44. |
| (35) £3893 6s. 8d.; £25 13s. 4d. | |

EXERCISE LVII.

- | | | |
|-----------------------------|------------------|------------------------------|
| (1) £1 2s. $4\frac{1}{2}d.$ | (2) £9 18s. 8d. | (3) £1 8s. |
| (4) £71 2s. | (5) £77 4s. | (6) £63 4s. $8\frac{1}{4}d.$ |
| (7) £85 2s. | (8) £36 3s. | (9) £17 14s. 2d. |
| (10) £31 5s. | (11) £96 6s. 8d. | (12) £71 13s. 4d. |

EXERCISE LVIII.

- | | | |
|---|----------------------------|------------------------------|
| (1) £50000. | (2) £4600. | (3) £6 9s. $7\frac{1}{8}d.$ |
| (4) £44 13s. | (5) £11831 5s. | (6) £150. |
| (7) £800. | (8) £1180. | (9) £12550. |
| (10) £2 0s. $2\frac{13}{16}d.$ | (11) £5800. | (12) £915. |
| (13) £398 7s. 6d. | (14) 12s. $2\frac{3}{4}d.$ | (15) £186 13s. 4d. |
| (16) £8. | (17) £1680. | (18) £171. |
| (19) £416 13s. 4d. | (20) £3800. | (21) £41 17s. 6d. |
| (22) £8400; cost of insurance £189. | | (23) £2 4s. $8\frac{1}{4}d.$ |
| (24) £33 6s. 8d. | (25) £18 4s. 11d. | (26) £13 11s. 5d. |
| (27) £500. | (28) £30. | (29) £749 8s. 8d. |
| (30) £50305; cost of insurance £1676 16s. 8d. | | |

EXERCISE LIX.

- | | |
|---|------------------------------------|
| (1) £3087; £420 6s. 8d. | (2) £578 16s. 3d.; £78 16s. 3d. |
| (3) £33185 5s.; £4518 11s. 8d. | (4) £9373 17s. 4d.; £1040 10s. 8d. |
| (5) £4569 15s. $2\frac{3}{8}d.$; £663 10s. $2\frac{3}{8}d.$ | |
| (6) £5624 6s. $4\frac{1}{2}d.$; £624 6s. $4\frac{1}{2}d.$ | |
| (7) £2187 18s. $2\frac{7}{10}d.$; £387 18s. $2\frac{7}{10}d.$ | |
| (8) £1095 18s. $6\frac{1}{50}d.$; £114 11s. $10\frac{1}{50}d.$ | |
| (9) £493039; £71164. | |
| (10) £158194 8s. $0\frac{1}{2}d.$; £21661 1s. $4\frac{1}{2}d.$ | |
| (11) £13400 19s. $1\frac{3}{80}d.$; £3400 19s. $1\frac{3}{80}d.$ | |
| (12) £184786 6s. 3d.; £18119 12s. 11d. | |
| (13) £2979 2s.; £279 2s. | |
| (14) £1965473 12s. $1\frac{1}{2}d.$; £498806 18s. $9\frac{1}{2}d.$ | |
| (15) £37698 9s. $9\frac{1}{2}d.$; £3531 16s. $5\frac{1}{2}d.$ | |
| (16) £615680 13s. 4d.; £75680 13s. 4d. | |
| (17) £103235 7s. $9\frac{1}{80}d.$; £19902 1s. $1\frac{1}{80}d.$ | |
| (18) £749363 13s. 4d.; £98322 0s. 0d. | |
| (19) £302132 2s. 9d.; £35465 9s. 5d. | |
| (20) £374681 16s. 8d.; £49161. | |
| (21) £16384; £3727 15s. | |

- (22) £324584 0s. 2d.; £60912 2s. 8d.
 (23) £1978874 11s. $3\frac{3}{80}d.$; £502207 17s. $11\frac{3}{80}d.$
 (24) £16074738 2s. $4\frac{4}{45}d.$; £2430738 2s. $4\frac{4}{45}d.$
 (25) £73248020 7s. $0\frac{139}{825}d.$; £12525364 2s. $0\frac{139}{825}d.$
 (26) £1687 5s. $11\frac{1}{25}d.$; £187 5s. $11\frac{1}{25}d.$
 (27) £16100 15s. $11\frac{1}{10}d.$; £700 15s. $11\frac{1}{10}d.$
 (28) £848 11s. $1\frac{244}{120}d.$; £98 11s. $1\frac{244}{120}d.$
 (29) £1147 1s. $3\frac{17337}{51300}d.$; £157 1s. $3\frac{17337}{51300}d.$
 (30) £11876 17s. $3\frac{53421}{400000}d.$; £1876 17s. $3\frac{53421}{400000}d.$

EXERCISE LX.

- | | | |
|--|---|------------------------------------|
| (1) 1s. 8d. | (2) 3s. 4d. | (3) 10s. |
| (4) £4 16s. | (5) £1 3s. | (6) Gain 15 per cent. |
| (7) 20 per cent. | (8) £1. | (9) $12\frac{1}{2}$ per cent. |
| (10) 1 lb. | (11) 5s. | (12) 6d. |
| (13) $16\frac{2}{3}$ per cent. | (14) 10 per cent. | (15) Loss $3\frac{3}{4}$ per cent. |
| (16) 18 per cent. | (17) Gain $12\frac{1}{2}$ per cent. | (18) Gains 16 per cent. |
| (19) £1 19s. | (20) 32 per cent. | (21) 20s. |
| (22) 8d. | (23) Loss $10\frac{5}{7}$ per cent. | (24) 3s. $10\frac{4}{5}d.$ |
| (25) Gain $18\frac{3}{4}$ per cent. | (26) Gain 50 per cent; entire gain £75 12s. | |
| (27) £14 9s. $8\frac{4}{5}d.$ | (28) 48s. | |
| (29) Gain 100 per cent.; entire gain £31 0s. 8d. | (30) £4 1s. 4d. | |

EXERCISE LXI.

- | | | |
|---------------------------------|---|---------------------------------|
| (1) £1698 2s. 6d. | (2) £11159 14s. $4\frac{1}{2}d.$ | (3) £2000 stk.; £100. |
| (4) £140. | (5) £5. | (6) £3678 16s. |
| (7) £609. | (8) £2000 stk.; £80. | (9) 90. |
| (10) £2887 10s.; £112 10s. | | (11) £2250. |
| (12) £4000 stock. | (13) £1702 10s. | (14) £10. |
| (15) £35 15s. | (16) £10 gain; £1 per cent. | |
| (17) £9 increase. | (18) £15984. | |
| (19) In the 3 per Cents. at 80. | | (20) $83\frac{1}{3}\%$ |
| (21) £16 13s. 4d. | (22) 93. | (23) £74 16s. $9\frac{9}{16}d.$ |
| (24) £9 7s. 6d. | (25) £20000. | (26) £5000 stock. |
| (27) £10. | (28) £177600. | (29) £3 2s. 6d. |
| (30) 80; £200. | (31) £3200. | (32) £17325. |
| (33) £78 18s. $1\frac{1}{2}d.$ | (34) £5000. | (35) 88. |
| (36) In the 4 per Cents. at 90. | (37) £647 5s.; £16 3s. $7\frac{1}{2}d.$ | |
| (38) £38000. | (39) $92\frac{1}{2}$. | (40) £2250. |
| (41) £1800. | (42) $84\frac{3}{4}$. | |

EXERCISE LXII.

- (1) 15000; 10000; 5000.
 (2) £370 8s. 4d.; £277 16s. 3d.; £222 5s.; £185 4s. 2d.; £158 15s. 0d.
 (3) Fine gold 4 oz. 7 dwts. 12 grs.; fineness 15 carats.
 (4) £55; £32 10s.; £42 10s.
 (5) £2355; £1884; £1695 12s.; £1413; £1224 12s.; £847 16s.
 (6) £780; £728; £351. (7) £814; £999.
 (8) Rent 18 and 20; profit 27 and 30.
 (9) $2518\frac{1}{8}$ lbs.; $204\frac{1}{2}$ lbs.; $\frac{53200}{3}$ s. = 2156000d.; 44000.
 (10) 15 cwt.; 2 cwt.; 3 cwt.
 (11) 190 gals.; 95 gals.; $47\frac{1}{2}$ gals.; 38 gals.; $9\frac{1}{2}$ gals.
 (12) $38\frac{1}{2}$ p.; $42\frac{1}{2}$ p.; $46\frac{3}{4}$ p.
 (13) £9 9s.; £6 15s.; £5 5s.; £25 16s.; gain per cent. $22\frac{2}{3}$.
 (14) £9; £7 6s. 8d.; £6 13s. 4d.
 (15) 5 tons 19 cwt. 2 qrs. 8 lbs.; 1 ton 4 cwt. 3 qrs. 18 lbs.; 7 cwt. 1 qr. 25 lbs.; cost £1134 12s. (16) £855; £1092; £1512.
 (17) 4 hrs. $24\frac{16}{31}$ min. (18) 160; 40; 30; 10.
 (19) A 4A. 0R. 20P., £1 1s. 8d.; B 3A. 0R. 15P., 16s. 3d.; C 2A. 1R. 36P., 13s.
 (20) Fineness 9, 12, 15, 18 carats; 15 dwts. 22 grs. As 113 : 327 ; 1049 : 4905 ; 778 : 4905 ; 1383 : 4905.

EXERCISE LXIII.

- (1) 9·43d., &c. (2) 2598 francs. (3) 3652·5 dollars.
 (4) £1 19s. $4\frac{59}{127}$ d. (5) £43 11s. $3\frac{45}{101}$ d. (6) £88.

EXERCISE LXIV.

- (1) 52. (2) 131. (3) 142. (4) 232. (5) 358.
 (6) 584. (7) 940. (8) 973. (9) $1\frac{3}{48}$. (10) $6\frac{4}{21}$.
 (11) 10·3. (12) 1·86. (13) 3·5. (14) 11·23. (15) 2·734.
 (16) 111·21. (17) $1\frac{21}{571}$. (18) $2\frac{32}{179}$. (19) $30\frac{11}{18}$. (20) 21347623.
 (21) 20·02. (22) $16\frac{1}{4}$. (23) $18\frac{2}{25}$. (24) $11\frac{1}{17}$. (25) $7\frac{3}{27}$.
 (26) 94·5055, &c. (27) 20·5807, &c. (28) 85·5836, &c.
 (29) 4683·43, &c. (30) 96·0966, &c. (31) 13.
 (32) 29. (33) 7. (34) 9.

EXERCISE LXV.

- | | | | | |
|------------------------|-------------------------|-------------------------|------------|------------|
| (1) 13. | (2) 42. | (3) 52. | (4) 101. | (5) 124. |
| (6) 165. | (7) 198. | (8) 231. | (9) 332. | (10) 572. |
| (11) 931. | (12) 997. | (13) 2·72. | (14) 32·4. | (15) 3·11. |
| (16) 58·8. | (17) 61·6. | (18) 8·52. | (19) 87·2. | (20) 9·17. |
| (21) $14\frac{1}{2}$. | (22) $9\frac{49}{53}$. | (23) $22\frac{7}{18}$. | (24) 98·5. | (25) 9·94. |
| (26) 937. | (27) 76·1. | (28) 8·32. | (29) 85·9. | (30) 714. |
| | (31) 8. | | (32) 9. | |

EXERCISE LXVI.

- (1) £26133 6s. 8d.
 (2) Men receive £486 8s. $7\frac{1}{2}$ d.; the women £270 4s. $9\frac{1}{2}$ d.
 (3) $\frac{2}{3}$; $\frac{13}{20}$. (4) 21 yds. 1 ft. 8 in.; 7·121; 9·79.
 (5) 10·190510142857. (6) £423 7s. $2\frac{2}{5}$ d. (7) 6034 $\frac{2}{3}$.
 (8) £12 10s.; 2133 $\frac{1}{2}$ bricks. (9) 61 yds. 0 ft. 9 in.
 (10) 16 feet. (11) $32\frac{9}{11}$ gallons. (12) 44 per cent.
 (13) £10 11s. $9\frac{27}{38}$ d. (14) £1 1s. $9\frac{1}{2}$ d. (15) £9546 16s. $2\frac{2}{3}$ d.
 (16) 25 per cent. (17) £2036. (18) £1674 and £2170.
 (19) $4\frac{1}{2}$ per cent. (20) 468. (21) 1 hr. 24 min.
 (22) $1\frac{1}{2}$ hour. (23) £17725 14s. $3\frac{2}{3}$ d. (24) £644.
 (25) £71 1s. $6\frac{2}{13}$ d. (26) £86 $\frac{2}{3}$.
 (27) £10 3s.; men receive £49 9s. $7\frac{1}{2}$ d.; the lads £35 6s. $10\frac{1}{2}$ d.; women £28 5s. 6d. (28) £73 15s.
 (29) 65415 sovs.; 1400 lbs. Troy.
 (30) 5 dwts. $3\frac{171}{223}$ grs. Troy; $4\frac{11084}{21802}$ drs.
 (31) Entire gain £5 17s. 6d.; gain 50 per cent.
 (32) £1003 10s. $5\frac{22}{33}$ d. (33) 84 $\frac{2}{3}$. (34) 1s. 3d.
 (35) £4260. (36) 20 men.
 (37) Entire gain £1 10s.; gain 25 per cent. (38) £9 0s. 10d.
 (39) Jointly in $6\frac{12}{37}$ days; A in $14\frac{2}{17}$ days; B in $18\frac{9}{13}$ days; C in $34\frac{2}{7}$ days.
 (40) 5s. (41) 13 cwt. 2 qrs. 3 lbs. 12 oz. $2\frac{2}{3}$ drs.
 (42) 144 days. (43) Income £730; rent and taxes £200 2s. 10d.
 (44) 65 apple trees, 39 pear, 13 plum; cost price £20 12s. 11d.
 (45) 19·5.

EXERCISE LXVII.

- | | | |
|---|-------------------------------|-----------------|
| (1) £13999 10s. $2\frac{1}{2}$ d. | (2) £1 11s. $7\frac{1}{2}$ d. | (3) 7040 steps. |
| (4) 2595 tons 5 cwt. 3 qrs. 12 lbs.; 28726 grs. | (5) £428. | |
| (6) £839 14s. $4\frac{1}{2}$ d. | (7) 901 rupees. | (8) 22862. |
| (9) £1844 15s. 10d. | (10) 2s. 6d. | (11) 17s. 6d. |

- (12) 50 miles. (13) £1682. (14) £8 11s. 10 $\frac{1}{2}$ d.
 (15) £481 5s. (16) 7 $\frac{23}{32}$; $\frac{49}{41}$. (17) 48·3; ·047.
 (18) 115·23; 111·11; 284604; ·0374; 2 $\frac{2}{13}$; ·0125; 2·0501; 59901;
 57·615; 62573; 6 $\frac{7}{16}$. (19) 185.
 (20) ·05675; £1 7s. 3d.; 10s.; £13 6s. 8d.; £15 3s. 11d.
 (21) ·011214; ·314. (22) $\frac{275}{582}$; $\frac{5}{14}$. (23) 3 qrs. 21 lbs.; ·0625; ·2.
 (24) ·628125; 4·628125. (25) 3 $\frac{36}{91}$.
 (26) 1s. 11d.; ·43625; ·0976510416.
 (27) 6·25; 0·0384759375; 3·54; 736; 476·88; 8·4; 37·56.
 (28) 15 $\frac{5}{8}$. (29) £651 13s. 4d. (30) 1 $\frac{7}{8}$; $\frac{9}{16}$.
 (31) £251 14s. 4 $\frac{1}{2}$ d. (32) £175, £250, £325. (33) 11 months.
 (34) £2450 8s. (35) £5 12s. (36) 121 miles.
 (37) 30 pumps. (38) 499440 bricks. (39) £19 6s. 9d.
 (40) 84 days. (41) £1 2s. 6d. (42) £17 2s. 2 $\frac{1}{2}$ d.
 (43) £16478 8s. 9d. (44) £857 2s. 10 $\frac{3}{4}$ d. (45) 10 grains.
 (46) 8 horses. (47) £62 2s. (48) 12 $\frac{5}{8}$.
 (49) £1354 3s. 4d. (50) 104 $\frac{5}{8}$. (51) 64 days.
 (52) $\frac{3}{16}$; 1875. (53) 3 ft. 9 in. (54) 2·6457, &c.
 (55) £187 10s.

EXERCISE LXVIII.

- (1) 2 $\frac{23}{8}$. (2) 104 $\frac{1}{8}$ lbs. (3) 16 $\frac{7}{8}$ days.
 (4) 10·4318. (5) 37 $\frac{7}{12}$ yards. (6) 2 $\frac{4}{15}$.
 (7) 512. (8) 6 $\frac{3}{8}$. (9) £5 18s. 4d.
 (10) £1000. (11) 18 $\frac{3}{4}$ per cent. (12) £15 0s. 11 $\frac{1}{2}$ d.
 (13) 2 $\frac{57}{178}$. (14) £14 8s. (15) 6 $\frac{3}{4}$ days.
 (16) 1s. 8d. (17) 12 $\frac{19}{36}$ yards. (18) 2 $\frac{3}{17}$.
 (19) ·801, &c. (20) £2 18s. 11 $\frac{327}{391}$ d.
 (21) Dif. of income £16 6s. 2 $\frac{82}{137}$ d. (22) 685 $\frac{5}{7}$ no. of oranges.
 (23) £500. (24) 63 $\frac{1}{3}$ increase of income per cent.
 (25) 2 $\frac{23}{30}$. (26) £53 11s. 6 $\frac{3}{4}$ d. (27) 3s.
 (28) 18·7 lbs. (29) £9 6s. 8d. (30) 5 $\frac{7}{8}$.
 (31) 23. (32) 3 years. (33) £24960.
 (34) £2350. (35) 1s. 1 $\frac{1}{8}$ d. (36) 5 $\frac{1}{2}$ d.
 (37) 9s. 1 $\frac{1}{2}$ d. (38) £1305 18s. 0 $\frac{1}{4}$ d. (39) 16 days.
 (40) £6 9s. 10d. (41) 29 $\frac{1}{31}$ minutes. (42) 22 $\frac{11}{16}$.
 (43) 611. (44) £3 $\frac{3}{8}$. (45) £26 13s. 4d.
 (46) 14 $\frac{7}{12}$ per cent. (47) 1541. (48) £290 6s. 8d.
 (49) 25313 $\frac{13}{25}$. (50) 38 $\frac{5}{8}$. (51) £30 $\frac{5}{64}$.
 (52) 50 per cent. (53) 40·6. (54) 24813·23.
 (55) 12 per cent. (56) £166 17s. 2 $\frac{1}{2}$ d. (57) 18s. 9d.

- (58) $7\frac{12}{35}$. (59) £587 $\frac{37}{48}$. (60) 60.
 (61) 44. (62) 23464 $\frac{151}{308}$. (63) 18 per cent.
 (64) £250 5s. 9 $\frac{3}{4}$ d. (65) 17s. 2 $\frac{1}{4}$ d. (66) 6 $\frac{902}{1246}$ d.
 (67) 600 $\frac{600}{715}$. (68) 26. (69) $\frac{54653}{90808}$.
 (70) 3 fur. 27p. 4 yds. 0 ft. 3 $\frac{1}{2}$ in. (71) 3620.
 (72) 837. (73) £181 1s. 5 $\frac{201}{2467}$ d. (74) 2s. 1d.
 (75) £2 5s. 0d. (76) 70 ft. 3 in. 8' 10" 4''' ; 70 ft. 44 $\frac{31}{38}$ in.
 (77) £292 10s. (78) 742. (79) 312 acres.
 (80) £115 4s. (81) 9 ft. 2 in. 7' 2" 5''' . (82) $\frac{17}{85}$. (83) 5 per cent.
 (84) 30 $\frac{1}{2}$ cwt. nitre; 3 $\frac{1}{2}$ cwt. sulphur; 5 $\frac{1}{2}$ cwt. charcoal. (85) £10020.
 (86) 35·410714285. (87) £428 11s. 5 $\frac{1}{4}$ d. (88) £2107 10s.
 (89) 120000. (90) £78 $\frac{1}{8}$ stk. or £75. (91) 3 $\frac{111}{83}$ and 4 $\frac{26}{81}$.
 (92) 3·13 nearly. (93) 50 per cent. (94) 19s. 2d. per gallon.
 (95) 579. (96) 100956. (97) 2 ft. 3 in.
 (98) 30 minutes. (99) 3 $\frac{1}{4}$ per cent. (100) 38 $\frac{3}{4}$ hours.
 (101) 12 mls. : 22 $\frac{1}{2}$ mls. (102) 50 $\frac{3}{13}$. (103) 1·794, &c.
 (104) 12 ft. 9 in. 0' 0" 8" 11''' . (105) 12 cub. ft. 1296 $\frac{107}{144}$ in.
 (106) 28·6578947, &c. (107) 26·5435416. (108) £29 16s. 7 $\frac{82}{283}$ d.
 (109) £2 15s. 3d. (110) 66 $\frac{2}{3}$. (111) 17 $\frac{1}{5}$ days.
 (112) 3 min. 46·8 sec. (113) 10·55 min. A.M. (114) $\frac{1}{4}$.
 (115) 26·1509125. (116) 18s. 9d. per gal. (117) 22 $\frac{1}{4}$ years.
 (118) 5 $\frac{85}{123}$ gain per cent. (119) 18495000.
 (120) Increase £52 10s. (121) 88 $\frac{6}{13}$. (122) 10 : 75 or 13 $\frac{1}{3}$ p.c.
 (123) 128 $\frac{19}{12}$. (124) 18 $\frac{74}{377}$ loss per cent. on interest.
 (125) £7092 $\frac{28}{141}$; 8·51 p.c. (126) 82 $\frac{1}{7}$. (127) See pages 123 and 124.

EXERCISE LXIX.

- (1) £4651143 2s. 0d. (2) £5149668 12s. 2d.

EXERCISE LXX.

- (1) 635 lbs. 6 oz. 5 dwts. 7 grs. (2) 6 cwt. 0 qrs. 3 lbs.
 (3) £9 11s. 6 $\frac{3}{4}$ d. (4) 211266 sq. ft. (5) 1s. 3d.
 (6) £15 12s. 9 $\frac{3}{4}$ d. (7) 7 wks. 2 dys. 7 hrs. 23 min. 27 sec.
 (8) £10125. (9) £21 6s. 6d. (10) 21 yds. 11 ft. 1216 in.
 (11) 13s. 1d. (12) £6 5s. 6d.

EXERCISE LXXI.

- (1) 695 lbs. 4 oz. 3 dwts. 9 grs. (2) 1s. 10 $\frac{1}{2}$ d.
 (3) £8 14s. 2d. (4) £250 2s. 6d. (5) $\frac{59}{84}$.
 (6) 1 $\frac{1}{17}$. (7) $\frac{1}{17}$. (8) $\frac{1}{130}$.

- | | | |
|---|---------------------------|-----------------------------|
| (9) 407·755812. | (10) 33·934899. | (11) 160504·9226. |
| (12) ·1144. | (13) £16 0s. 6d. | |
| (14) 71 mls. 4 fur. 14p. 5 yds. 1 ft. 2 in. | (15) 144 ft. | |
| (16) £26 17s. 8½d. | (17) £11 18s. 6d., &c. | (18) 16 $\frac{283}{336}$. |
| (19) $\frac{131}{180}$. | (20) $\frac{265}{6288}$. | (21) 6. |
| (22) 8004·709485. | (23) 11·57294. | (24) 1460·15448. |
| (25) 102·204. | (26) ·0027. | (27) 77591½ ft. |
| (28) 176½ acres. | (29) £5 1s. 0d. | (30) 8 years. |
| (31) 19 $\frac{7}{13}$. | (32) 7 $\frac{37}{88}$. | (33) 1. |
| (34) 20 $\frac{1}{40}$. | (35) 20135·2652434. | (36) ·005899. |
| (37) 21·812076. | (38) 1376284. | (39) 1·4318. |

EXERCISE LXXII.

- (1) 26·004; 4·06, &c. (2) £93 11s. 3 $\frac{5}{8}$ d.; see page 101.
 (3) 10·154875. (4) Gain 3 $\frac{13}{17}$ percent. (5) 100A. 3R. 17P.
 (6) £29 10s. 1 $\frac{7}{17}$ d. (7) £950400. (8) ·00003865562, &c.
 (9) 32 men; £115 4s. (10) 11 yds. 6 ft. 1113 in.
 (11) £4 14s. 1 $\frac{8}{11}$ d.; £11 14s. 0d. (12) 189 $\frac{1}{37}$.

EXERCISE LXXIII.

- (1) Fifty-five thousand five hundred and fifty-five.
 (2) 237237000; 90809; 90809. (3) £555 0s. 1d.
 (4) £4 4s. 4½d. (5) See page 4.
 (6) 10 oz. 10 dwts. 10 grs.; 3 cwt. 0 qrs. 3 lbs. 0 oz. 3 drs.
 (7) 182 days. (8) 88888 cubic inches.
 (9) 9d. (10) 10 hours.

EXERCISE LXXIV.

- (1) £2 6s. 8 $\frac{1379}{5459}$ d. (2) 3 $\frac{11}{30}$. (3) 2400·6; 24600; ·027045.
 (4) ·48. (5) £35. (6) £6 6s. 0d.

EXERCISE LXXV.

- (1) 999000 grs. (2) £222 2s. 2½d. (3) £313 3s. 3d.
 (4) $\frac{13}{4}$; 4. (5) £5 0s. 0d. (6) 60600; 6·006.
 (7) $\frac{7}{8}$; ·14625. (8) 1 $\frac{1}{80}$; 8·8.
 (9) 3 tons 4 cwt. 3 qrs. 4 lbs. 13 oz. (10) 171 bricks.
 (11) 3½ at 92 $\frac{5}{8}$. See page 101.

EXERCISE LXXVI.

- (1) 443206; 223130. (2) 7544676; 2038. (3) $\frac{7}{18}$; $\frac{1}{18}$; 7.
 (4) £23 19s. 3d.; £13 10s. 0d.; £10 12s. 8d. = £48 1s. 11d.
 (5) £152 15s. 0d. (6) 1s. 7 $\frac{1}{4}$ d. (7) 10·64 or 10 $\frac{16}{25}$.
 (8) 127 yards. (9) £311 0s. 1 $\frac{31}{80}$ d. (10) £154 3s. 4d.
 (11) £360, £144, £240. (12) £4347 6s. 2 $\frac{203}{1280}$ d. (13) £63 7s. 11 $\frac{25}{48}$ d.

EXERCISE LXXVII.

- (1) 162918. (2) 135765; 135765. (3) 57223.
 (4) £8 18s. 9d. (5) $\frac{14}{13}$. (6) 217.
 (7) £3 3s. 3d. (8) £161 7s. 3d. (9) ·495; ·015.
 (10) ·00102. (11) ·0394. (12) ·125.
 (13) £128 12s. 6d. (14) See page 2; 3162. (15) 1 $\frac{1}{18}$.
 (16) £33 5s. (17) 2s. 6d. (18) £11 5s. 6 $\frac{3}{4}$ d.

EXERCISE LXXVIII.

- (1) £21 1s. 8d. (2) £29 9s. 9d. (3) £4 4s. 6d.
 (4) £27 1s. 8d. (5) £20 0s. 3 $\frac{1}{2}$ d. (6) £52 16s. 4d.
 (7) £18 3s. 7d.

LONDON

PRINTED BY SPOTTISWOODE AND CO.

NEW-STREET SQUARE

